THIS ISSUE CONTAINS

numerous features by our
gular staff, as well as many
clusive articles by recog-
ed authorities, a few of
hich are listed below:

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Professor of
Petroleum Engineering at
Oklahoma University

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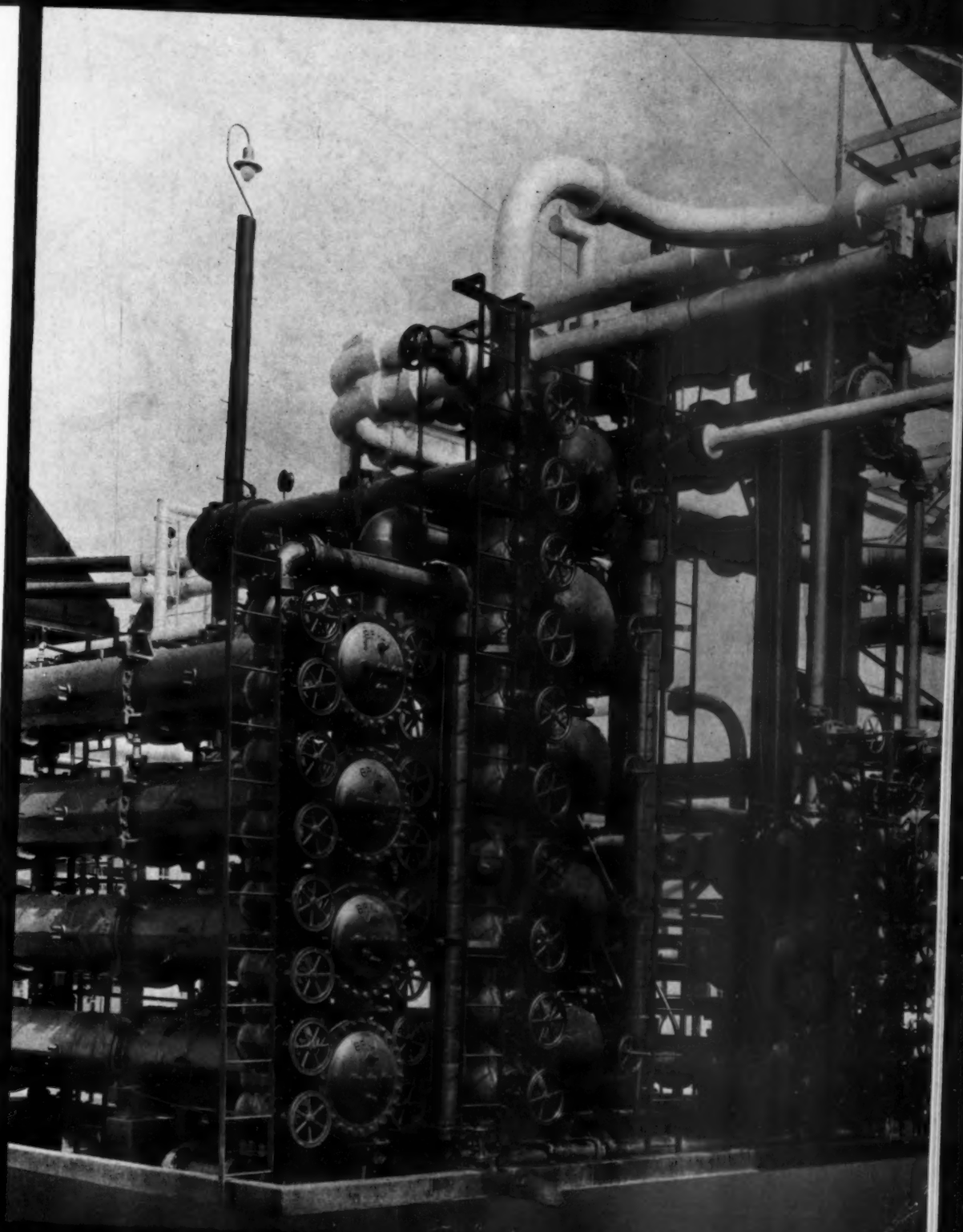
Master Mechanic
Sinclair-Texas Pipe Line Co.

COVER PICTURE

Heat exchangers in an
,000 barrel refining unit
California.



E ENGINEERING MAGAZINE OF THE OIL AND GAS INDUSTRY

The Sharples Process

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The Processes of Contact Filtration

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The Gyro Process
of
Vapor Phase Cracking

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The Samplitt

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The Mixitt

Petroleum Engineer

The Engineering Magazine of the Oil and Gas Industry

Edited and Circulated Only for Those Actively Engaged in the Operating Departments of the Industry

Volume 2 JANUARY, 1931 Number 4

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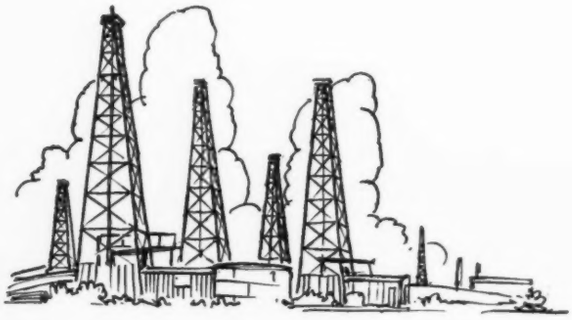

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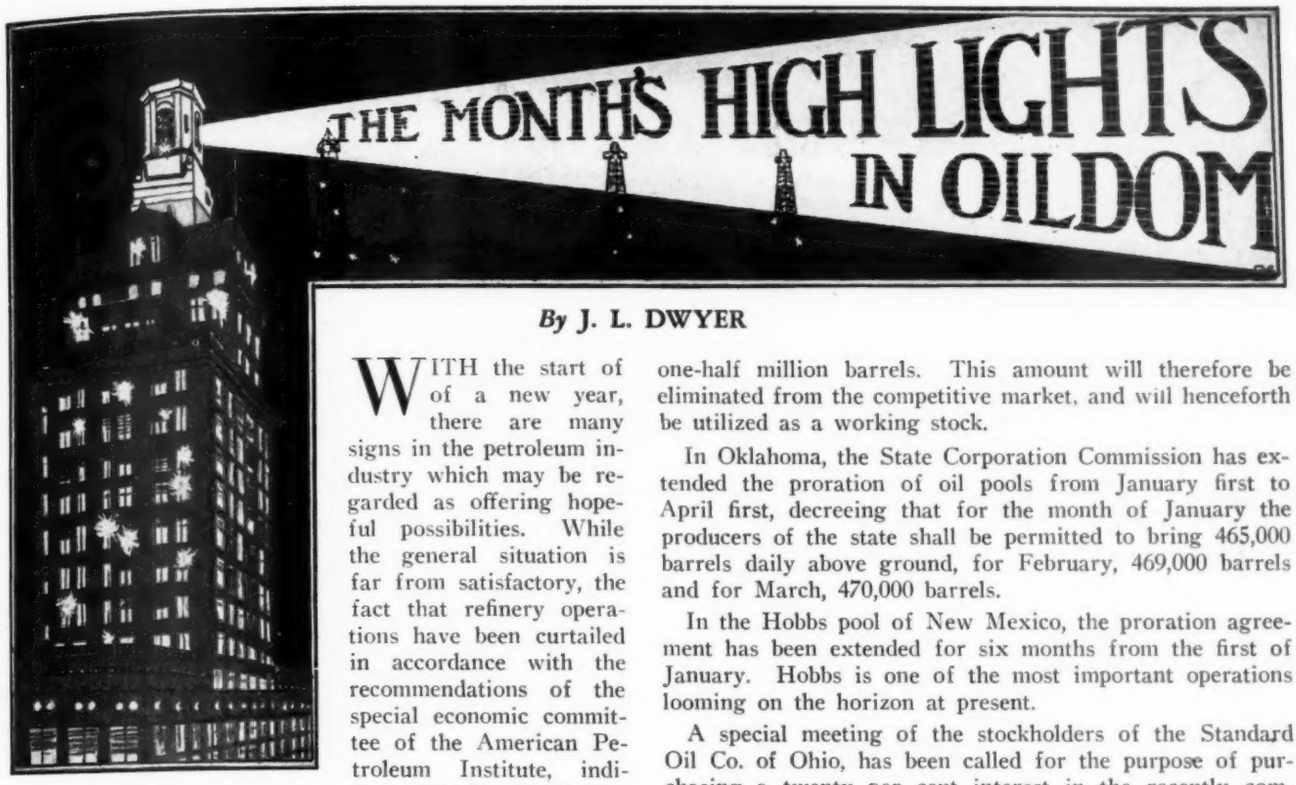


By **J. L. DWYER**

WITH the start of of a new year, there are many signs in the petroleum industry which may be regarded as offering hopeful possibilities. While the general situation is far from satisfactory, the fact that refinery operations have been curtailed in accordance with the recommendations of the special economic committee of the American Petroleum Institute, indicates that the oil industry will enter the spring gasoline season with refined stocks which are not cumbersome. At this time, the daily average amount of crude oil run to stills in refineries of the nation is lower than it has been for the past four and one-half years.

An inspection of the report of drilling activities which appears elsewhere in this issue reveals that the drill has been slowed down appreciably within the past few months.

While the potential production of crude has been substantially increased, the actual amount of oil brought above the surface has been reduced almost three-quarters of a million barrels daily below the high peak which was registered during the summer of 1929.

An interesting note in the gasoline situation is that within the next sixty days, two important gasoline lines will have been completed. These lines must be filled, and the amount of gasoline required to fill them will approximate one and one-half million barrels. This amount will therefore be eliminated from the competitive market, and will henceforth be utilized as a working stock.

In Oklahoma, the State Corporation Commission has extended the proration of oil pools from January first to April first, decreeing that for the month of January the producers of the state shall be permitted to bring 465,000 barrels daily above ground, for February, 469,000 barrels and for March, 470,000 barrels.

In the Hobbs pool of New Mexico, the proration agreement has been extended for six months from the first of January. Hobbs is one of the most important operations looming on the horizon at present.

A special meeting of the stockholders of the Standard Oil Co. of Ohio, has been called for the purpose of purchasing a twenty per cent interest in the recently completed Ajax Pipe Line which runs from Oklahoma to Wood River, Ill.

In Colombia, South America, a new legislative act was introduced which would cause some important changes in the producing and transporting situation of foreign-owned corporations. This act would provide for a reduced rate of royalties to be paid by the corporations, as well as permitting them a broader exploitation of the nation's resources.

While the Stanolind Pipe Line Co. announced that it would accommodate 1,500 barrels daily of the distress oil which is in the northeastern Oklahoma territory, no provisions have been made to take care of some 12,500 barrels from the stripper wells of this territory. The small refiners have been slowly absorbing many of the producers' connections, and it is hoped that the end of the month will witness all of the distress oil which has been without pipe line connections since January first, being furnished with an outlet.

Production and Refining Figures Furnished by the American Petroleum Institute

Crude Runs to Stills, Gasoline and Gas and Fuel Oil Stocks, Week Ending December 27, 1930

(Figures in Barrels of 42 Gallons)

DISTRICT	Per Cent Potential Capacity Reporting	Daily Average Crude Runs to Stills	Per Cent Operated of Total Capacity Reporting	Gasoline Stocks	Gas and Fuel Oil Stocks
East Coast	100.0	458,000	74.8	5,780,000	9,957,000
Appalachian	93.8	77,600	58.6	1,005,000	1,044,000
Ind., Ill., Ky.	97.5	242,400	63.6	4,489,000	3,547,000
Okla., Kan., Mo.	89.4	227,700	55.2	2,808,000	4,293,000
Texas	91.9	484,700	65.2	6,813,000	10,760,000
Louisiana, Arkansas	98.3	144,900	55.3	1,514,000	2,303,000
Rocky Mountain	93.1	39,300	28.1	1,642,000	996,000
California	98.8	532,800	60.0	15,337,000	104,017,000
Total Wk. Dec. 27	95.7	2,207,400	61.8	39,388,000	136,917,000
Total Wk. Dec. 20	95.7	2,333,100	65.3	38,621,000	137,017,000
The Texas and Louisiana Gulf Coastal figures shown below are included above in the totals of their respective districts.					
Texas Gulf Coast	100.0	366,700	69.3	5,379,000	8,064,000
Louisiana Gulf Cst.	100.0	99,300	67.3	1,253,000	1,356,000

Daily Average Production

(Figures in Barrels)

	Dec. 27 1930	Nov. 29 1930	Dec. 28 1929
Oklahoma	458,100	506,350	647,550
Kansas	108,800	111,700	113,800
Panhandle Texas	57,250	74,850	102,600
North Texas	58,150	63,750	88,100
West Central Texas	28,900	42,300	54,000
West Texas	239,150	266,100	341,200
East Central Texas	40,550	40,700	23,550
Southwest Texas	82,100	93,650	74,950
North Louisiana	42,000	44,050	38,000
Arkansas	50,950	51,950	60,600
Coastal Texas	159,900	162,400	138,850
Coastal Louisiana	26,150	26,550	19,750
Eastern (not including Mich.)	100,000	110,000	128,200
Michigan	8,800	7,300	14,550
Wyoming	47,150	46,900	49,300
Montana	6,600	4,950	10,200
Colorado	4,100	4,200	5,400
New Mexico	42,300	45,050	7,700
California	565,800	601,800	689,400
Total	*2,126,750	2,304,550	2,607,700

*Lowest daily average production since week ending July 31, 1926, when it was 2,115,850 barrels.

Determination of an Oil Well's

WHEN the production of an oil field of diversified ownership interests has to be curtailed, it is becoming general practice to resort to proration, the chief object of which is to allow each well to produce at an equitable rate an equitable share of the oil and gas content of the pool or reservoir, to conform to the imposed reduced rate of output from the field. What the equitable rate of a well should be usually is established by an individual test of the well's potential production.

On what should the method of obtaining the potential production of an oil well be based—the underground natural physical conditions that obtain within the pool or reservoir, or the artificial conditions set up in the well by the size and arrangement of casing, flow string, or other mechanical equipment installed in or on the well?

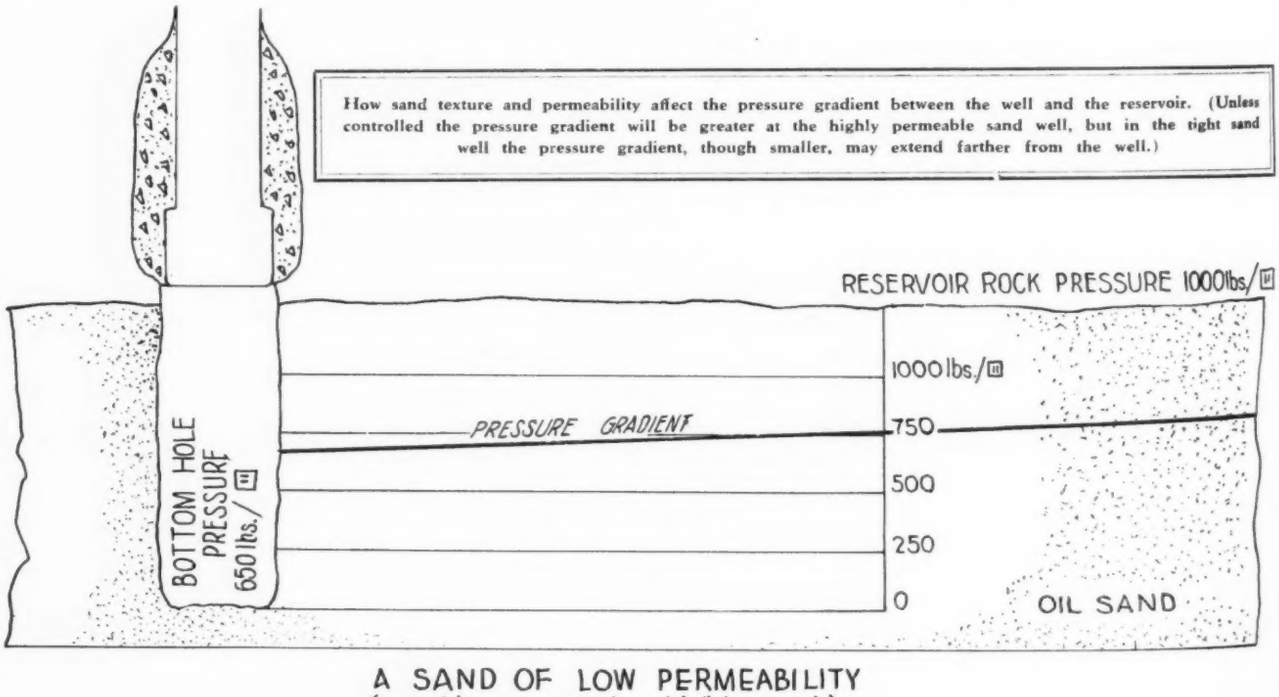
A satisfactory answer to this question, free from specious theory and acceptable to the producer, should point the way to the working out of a suitable method, equitable and fundamentally sound, of determining the potential production of an oil well.

There is probably no term in our industry more generally misunderstood than "potential production." It has recently been the subject of much controversy. Efforts to change what now must be considered purely theoretical calculations to incontrovertible evidence of what an oil well can produce will unquestionably be welcomed by the petroleum industry. Additional features of this problem will be discussed by Mr. Sclater in a succeeding article.

In a flush field where large volumes of oil and gas are involved, the method of determining the potential production of a well is of great consequence. From an operating standpoint, one of the most important technical problems confronting the producer today is this one of working out a suitable method, equitable and fundamentally sound, for determining the potential production of a flowing oil well without recourse to the arbitrary procedure, followed at present in many fields, of producing a well wide open for a stated short period of time. In areas of large flush production and high gas pressure the urgent need for a satisfactory solution to this problem is most apparent, for there the liability of doing irreparable damage to the pool or reservoir in following such a procedure is greatest. Aside from the hazards involved in opening a well up to its maximum (temporary) rate of flow to determine its potential oil production, the method in itself, while practical, has serious defects and is far from being equitable, as manipulation of the well rather than energy considerations within the reservoir is virtually the basis of such an arbitrary method of determination.

The inadequacy of this method of obtaining a well's potential has, of course, been recognized. Well potentials in many of the flush fields in the Mid-Continent now are partly determined from decline curves. In the Hobbs field, New Mexico, flow through a certain size tubing under stipulated conditions is in use for the determination of a well's potential. A commendable effort has been made in the Yates field, Texas, to approach the problem of determining the potential of a well from its rate of flow at different bottom-hole pressures. Underground conditions in the Yates pool are perhaps more favorable for this method of determination than is the case in the average field. There the wells are shallow, gas-oil ratios within the reservoir are reasonably low, the rock pressure — about 700 pounds per square inch—presents no serious hazards, the producing horizon is fairly persistent throughout the field and, probably most important of all, a hydrostatic head contributes

How sand texture and permeability affect the pressure gradient between the well and the reservoir. (Unless controlled the pressure gradient will be greater at the highly permeable sand well, but in the tight sand well the pressure gradient, though smaller, may extend farther from the well.)



Potential Production

By
K. C. SCLATER

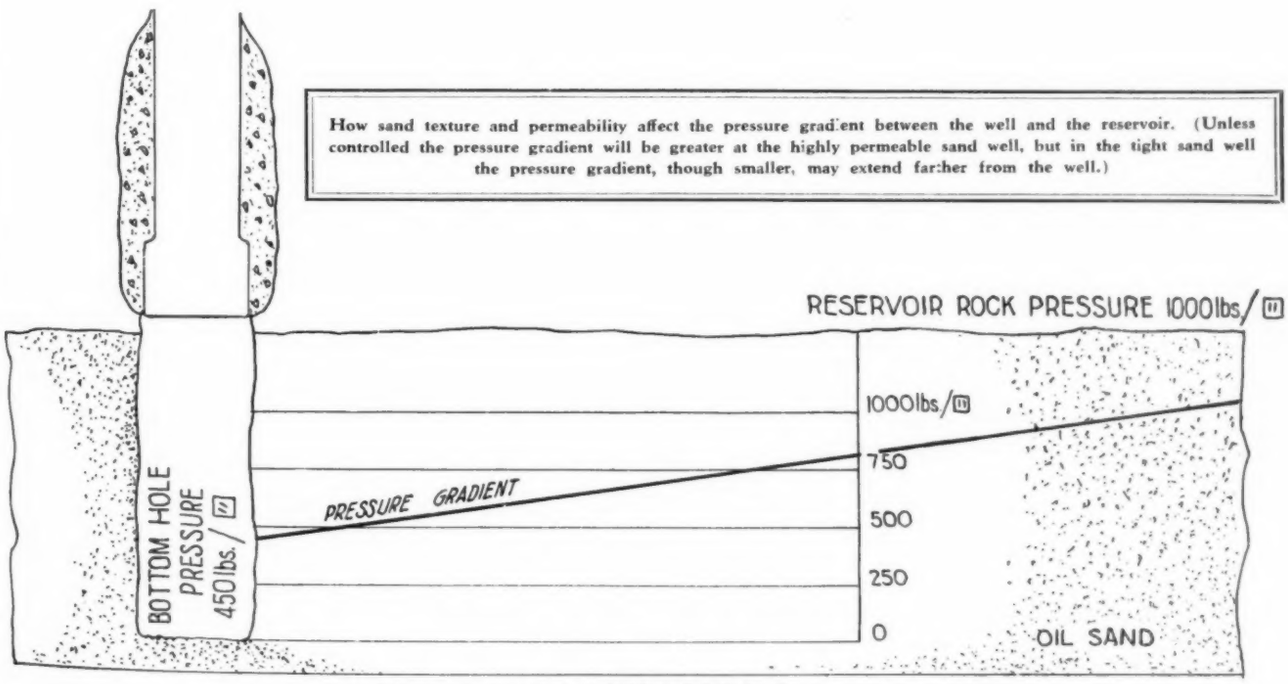
a considerable proportion of the rock pressure, thus tending to maintain the rock pressure uniform in all parts of the field when the wells are produced at a slow rate under back pressure. Recently it has been suggested that the open flow method of determining a well's potential is wholly inadequate[1] and, to correct this, some investigative work has already been done in the field toward formulating a plan of procedure that could be applicable to any oil well without the necessity of placing the well on open flow and allowing it to produce at its maximum rate, unrestricted.

There is much confusion regarding what is meant by the potential production of an oil well. As ordinarily understood, and as implied by the prevailing methods of obtaining it, the potential production of an oil well is the quantity of oil the well would produce if allowed to flow at its maximum rate, whatever that may be. Such a loose definition permits of a wide variance of conditions at or in the well and, unless these conditions are definitely stated and thoroughly understood, there always will be confusion regarding the term potential production. For example, the size of the hole, the amount the producing horizon is penetrated, the size and arrangement of the well connections at the surface, all influence the rate of flow, and hence the quantity of oil produced by the well. If equitable rates of flow are to be established what stipulations, if any, should be made regarding these? An answer to this question must be sought only after considering what is an equitable rate of flow and how it should be determined; we will therefore return to this question later.

[1] "Improvements in Production Practice," by W. W. Scott. A. P. I., Chicago, November (1930) meeting. See part of this paper, "Determination of Potential Production of Wells Without Open-Flow Test," by T. V. Moore.

It was already mentioned that the main object to be accomplished in prorating production is to allow each well to produce at an equitable rate, an equitable share of the oil and gas content of the pool or reservoir, to conform to the imposed reduced rate of output from the field. In an oil pool there is a definite quantity of energy present. (By oil pool is meant a geologic structure or natural underground reservoir containing oil and gas and having free communication from any one part to another, or where the energy source, gas or hydrostatic pressure is common to all parts of the pool.) If the main propulsive agent is natural gas pressure, the energy will be present in the form of compressed free and/or dissolved gas in the oil. Another source of energy might be hydrostatic pressure. These sources of energy are the common property of the pool. Because of their fugacity, the gas-oil fluids in the reservoir have a tendency to migrate from areas of high pressure to areas of low pressure. As the oil and gas are produced by the well a pressure gradient is established between the reservoir and the well. After a time, if the well continues to produce, an area of depleted pressure in the sand develops around the well as a result of oil and gas drainage. The extent of this depleted area will depend on the volume and rate of withdrawal of the oil and gas, and also on the physical character of the producing sand, such as its texture and permeability. If the principal propulsive agent is natural gas pressure, the decline in rock pressure will be an index of the reduction of energy in the pool. This, of course, assumes that there is no underground leakage to barren horizons or thief sands, such as might result from defective casing, casing seats, or other

How sand texture and permeability affect the pressure gradient between the well and the reservoir. (Unless controlled the pressure gradient will be greater at the highly permeable sand well, but in the tight sand well the pressure gradient, though smaller, may extend farther from the well.)

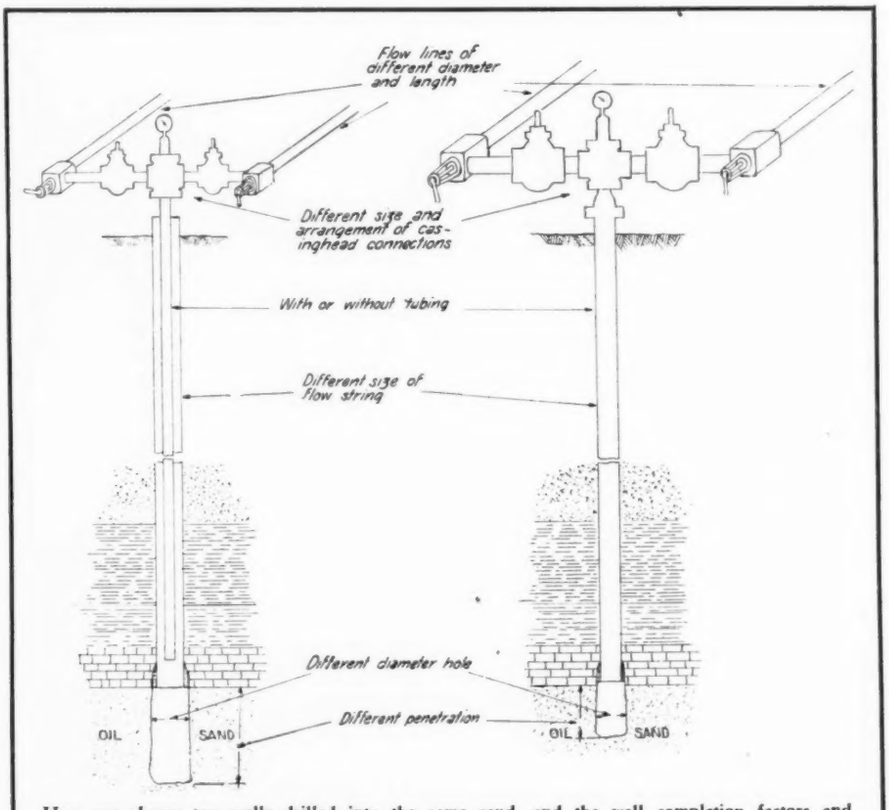


causes. If hydrostatic pressure is present and the rate of withdrawal of oil and gas does not overcome the rate at which the water can follow up the gas-oil fluid in the sand, the hydrostatic pressure can be considered constant and the rock pressure is then only a partial index of the energy depletion in the sand. In either case, the withdrawal of excessive volumes of oil and gas from any one well will be reflected in all parts of the pool by a reduction in rock pressure. The ultimate result will be an increase in subsequent lifting costs at every well in the pool and a diminished ultimate recovery of oil. Producers today cannot afford to ignore the fact that subsequent lifting costs are profoundly influenced by the production methods followed and how wells are handled in the early life of the field. It follows, then, that an equitable rate of production would be a rate of withdrawal of oil and gas that would result in a uniform rate of rock pressure diminution (measured opposite the producing horizon in the well) at every well in the pool.

Even this would not cover every condition met with. Consider a very porous sand of high permeability wherein the fluids oil or gas could travel with facility through the sand; in other words, the sand is so open that it offers little resistance to the flow of oil and gas. Under such conditions there would be a rapid readjustment of reservoir pressures. Great volumes of oil and gas could be withdrawn from a well without creating a pressure gradient between the reservoir and the well that differed greatly from the average well in the field; nevertheless, the oil and gas could be withdrawn at a rate that would be far from equitable. Or again, consider sand of medium or average permeability wherein large volumes of free gas are associated with the oil or where the gas-oil ratio is abnormally high; in such a sand it would be possible to produce large volumes of gas through one well and still maintain a uniform rate of rock pressure decline conforming to the average well in the pool; nevertheless, the rate of production would not be equitable. Where such underground conditions exist they should be given due recognition when well potentials are determined and means devised to prevent any well from producing at such a rate that might injure other wells in the pool. Means for determining an equitable rate of flow is so closely related to the main problem of suitable methods of obtaining a well's potential, that they will be discussed together later.

What is an equitable share of the oil and gas content of a pool? It is assumed that this is the quantity of oil and gas that underlies the acreage held. Thus, if vertical barriers could be passed through the boundary lines of the property at the surface and extended an indefinite depth underground, the owner of the lease enclosed by said boundaries would be entitled to all the oil and gas in that portion of the pool within the hypothetical vertical barriers. While this is a simple theoretical conception of what constitutes an equitable share in an oil pool, fortunately or unfortunately, making a reliable estimate of what lies underneath is a very difficult problem. It is necessary to have accurate data regarding the thickness and lateral extent of the producing horizon, its porosity and saturation, how the gas and oil are associated, the reservoir temperature and the rock pressure. Such information must be obtained by drilling, either prospect core holes or wells. If this information were available, and used together with accurate cumulative records of the total volume and character of the gas and the total quantity of oil produced from the pool, equities could be adjusted on an accurate basis. Save for estimates made chiefly from purely theoretical deductions, no attempt has yet been made to go to the extent of reconciling proration equities in a pool on the basis of proportional underground estimates. Lack of the proper type of instruments and equipment has retarded the development of methods for obtaining, at reasonable cost, data sufficiently accurate and convincing with which to make underground estimates close enough to be of real practical value.

It would seem then that the whole problem of determining an oil well's potential is also one of establishing and maintaining equitable rates of flow at the individual wells.



Here are shown two wells drilled into the same sand, and the well completion factors and mechanical arrangements in and on the well that influence the rate of flow from the well.

Gelatin Shot Extinguishes Defiant Well Fire

By WARREN L. BAKER

COURAGEOUS, incessant and systematic human effort employing man-made devices proved again that they were capable of subduing the defiance of an unruly blazing oil and gas well when the Deep Rock Oil Corporation's No. 2 A. B. Douglas burning well was snuffed out with a charge of gelatin at eight o'clock a. m., December 22.

The well, located one mile south of Wewoka, Seminole County, Oklahoma, blew 1500 feet of four-inch, 20-pound drill pipe from the hole and through the derrick about one-thirty o'clock in the morning on December 19, catching fire immediately. It is believed that the gas was ignited from sparks resulting from the drill pipe striking another piece of steel. At the time this happened the drilling crew was running the drill pipe out of the hole after making a drill pipe test of the production.

The roaring torch was fed by an estimated 60,000,000 cubic feet of gas and several hundred barrels of oil per day through 8¼-inch casing from a depth of 3119 feet. At night the brilliant light could be seen for 50 miles as it rose 150 feet into the air. The heavy gas flow had been encountered about a week previous to the outbreak of the fire. At that time the well actually gauged 47,000,000 cubic feet of gas, and was being drilled deeper to penetrate an underlying oil-producing horizon when additional gas and some oil exerted such a pressure that the rotary drilling mud was unable to hold it in control.

M. M. Kinley and his brother, F. T., of Tulsa, famed for their ability in conquering oil and gas well fires all over the world, were called immediately to the scene and took complete charge of all work. Their knowledge of such conditions and untiring efforts, assisted by the willingness and unceasing energy of the Deep Rock company and Summit Drilling Company men, won the fight.

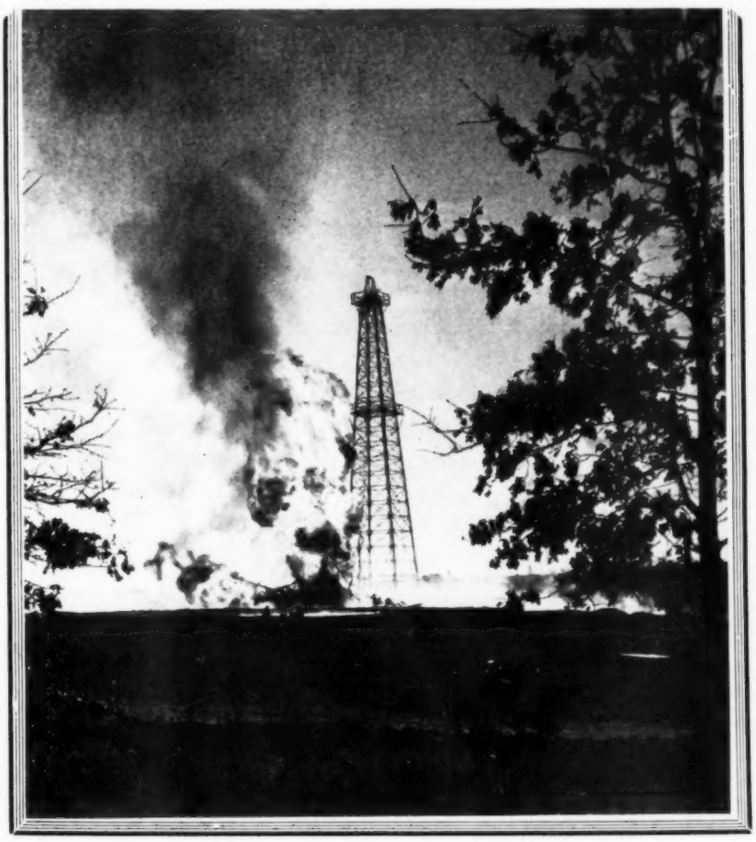
Flame Extinguished

The flame was extinguished by a 50-quart shot of blasting gelatin, a high explosive of collodin-cotton and nitroglycerine. The explosion had the effect of separating the flow of gas coming through the casing from the flames in the air for a period of time sufficient to allow the fire to exhaust itself for lack of fuel.

The two Kinley brothers carried the charge of explosive to the mouth of the well. A fuse running from a blasting battery was attached to the shot and transferred electric current to the gelatin, causing it to explode. Immediately there was a great blast that shook the ground and threw masses of debris into the air. As suddenly as it had begun the fire was over and there remained only the wild rush of gas and oil without the accompanying blaze.

The gelatin charge resembled a large bundle, wrapped in asbestos and securely tied. The charge was placed in a shelf, similar to a V-shaped hog trough, which was covered with tin to prevent its burning.

The shot that blew the fire out was the third one of gelatin to be discharged. The first shot was of 17 quarts. It was primarily for the purpose of dislocating the rotary turntable, which was setting down and encircling the projecting portion of the casing. It had not been possible to raise this heavy piece of machinery up over the end of the casing and permit its withdrawal from the burning area. As soon as tow lines had been attached and tractors and trucks had dragged this equipment, bringing with it the top nipple of the casing, out of the fire, the flame went up in a single huge column, the force of which kept the gas from breaking into flames until it was up off the ground. This greatly simplified the extinguishing of the fire, as it reduced the hazards of the work and the possibility of the gas becoming reignited after a shot.



Wild Abe, burning near Wewoka, Okla.

The first and second shots were handled and discharged in a similar manner to that of the third one, as already described. The second explosion was of 30 quarts. It threw considerable debris and for a moment appeared to have been successful in ending the flamboyant torch, but within a twinkle of an eye the gas was afire again.

After the wreckage had been cleared away from the site it took the Kinley brothers but about 30 minutes to prepare and set off the first shot, with a slightly longer time expiring

before the second shot. The third attempt was delayed until additional gelatin could be brought to the well. All of the many tiny pieces of debris surrounding the mouth of the well were removed during this period, and the ground was kept soaked with water to keep it as cool as possible.

Preparatory Work

The greatest amount of time in putting out the fire was spent in removing the steel wreckage which a short time before had been modern drilling equipment. The derrick, carrying with it much weighty drill pipe and other equipment, fell over the hole and became a twisted, badly burned mass of metal. This caused the spread of the flame until practically all the wreckage was engulfed. All of the ruins had to be removed before the shot to make it successful.

The removal of the wreckage consumed from the time the well caught fire until about three p. m. December 21, when the first shot was exploded. This work was greatly hindered by the flow and consequent flame coming from the mouth of a cellar flow line. A north wind played this blaze across the mass of steel most of the time and prevented easy entrance. After this fire was put out (about ten a. m. December 21), work of towing the rig remains out was accomplished in rapid order.

The Kinley brothers by heroic disregard of the heat and flames were able to put out this flow line fire. All of the spokes from a valve hand wheel were cut away from the square box in the center. The box was then welded on the end of a 20-foot piece of small pipe. The pipe extension enabled them to place the box over the square-head of the control stem on a six-inch gate on the flow line. While protected from the fire by a shield and water, they turned the pipe with wrenches to close the gate.

There followed a period of great rushing labor until the last of the debris was removed that afternoon. Acetylene torches played quite an important part in the taking out of the debris. Time and again pieces had to be cut away from the matted wreckage before it could be removed.

Water, the pressure for which was generated in an oil field boiler, was played on the men while they worked among the heated wreckage. At times it was used quite strategically, its force being directed against a portion of the flame to keep it away from the workers who were up next to the blaze itself. It was also used to cool pieces of equipment to which tow lines were being attached.

Piece by piece, section by section, the remains of the rig were towed away by trucks and tractors. When a tractor had pulled a part of the wreckage out from the fire a truck dragged it away while the tractor returned to draw another section out. Oftentimes it was necessary to anchor the tractors with a truck, due to the weight of the equipment. When the last of the wreckage was being removed and was coming in great matted masses, a truck was anchored to a tree while its winch line was fastened to a tractor that was connected with the wreckage.

When the work of towing the pieces of equipment out of the fire was commenced, the pulls were usually direct ones from the equipment or section of the derrick to a tractor or truck, but later a large pulley was used. A line running from the winch of a truck, which was anchored, ran through the pulley to the tractor. This way the tractors and trucks tugged and strained to their utmost without breaking the wire line cables.

As the equipment was gradually removed the main flame became a

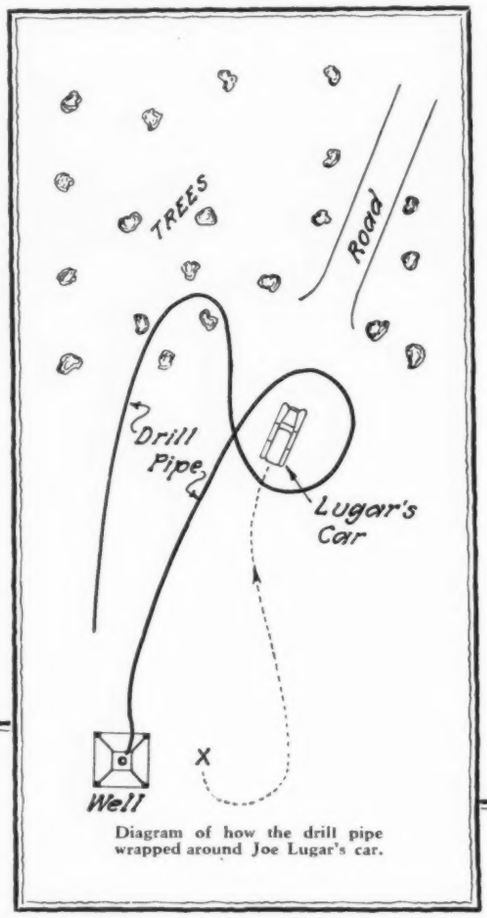
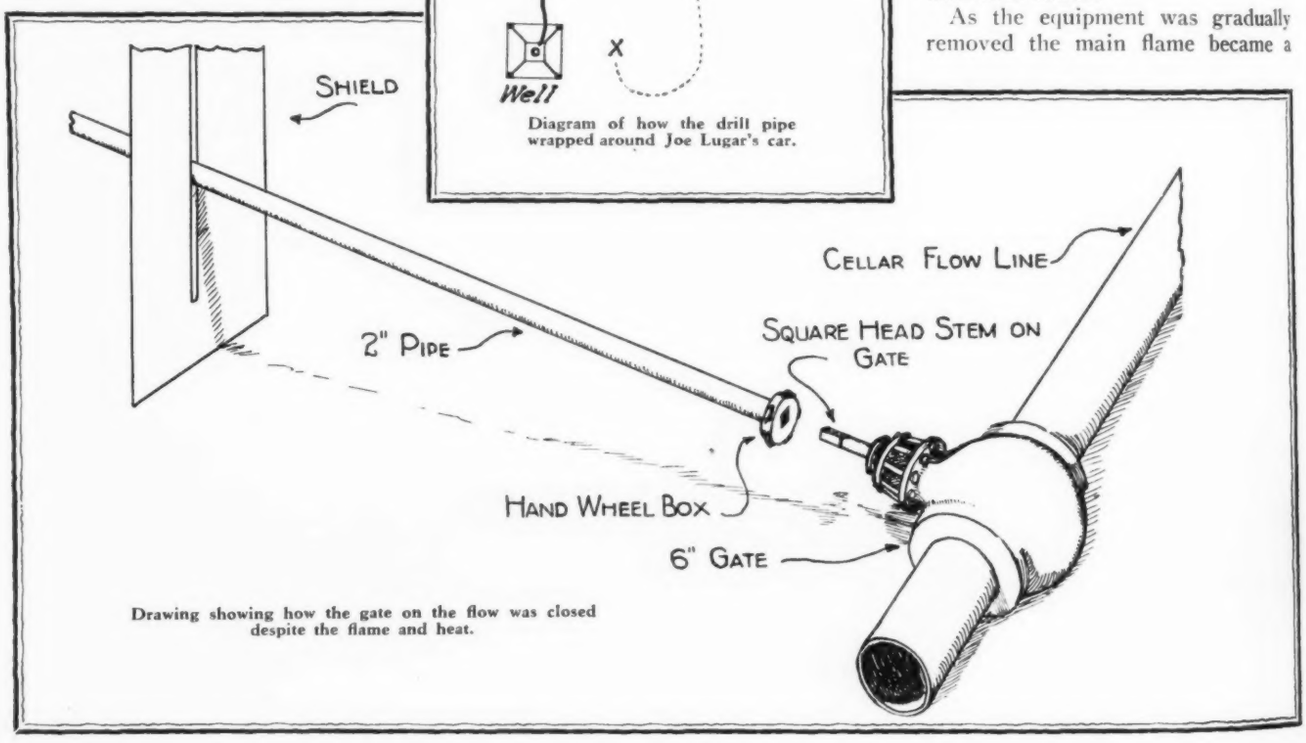


Diagram of how the drill pipe wrapped around Joe Lugar's car.



Drawing showing how the gate on the flow was closed despite the flame and heat.

huge single column, especially when a separator was pulled from the twisted mass of steel. This aided in the speeding up of work.

Workmen employed sheet metal shields for protection from the terrific heat. These were fashioned at the well site from sheets of galvanized tin, with sufficient wooden legs for support. In most of the protectors holes were cut for the men to look through and get directions from the Kinleys, and also for the spraying of water.

Immediately after the putting out of the fire, work was started on capping the output of the well. At 6:30 p. m., December 22nd, or that same afternoon, this had been accomplished by the use of a master-gate with a die-nipple, which screwed up on the casing, closing the mouth. This equipment was lifted in place by a portable standard drilling machine.

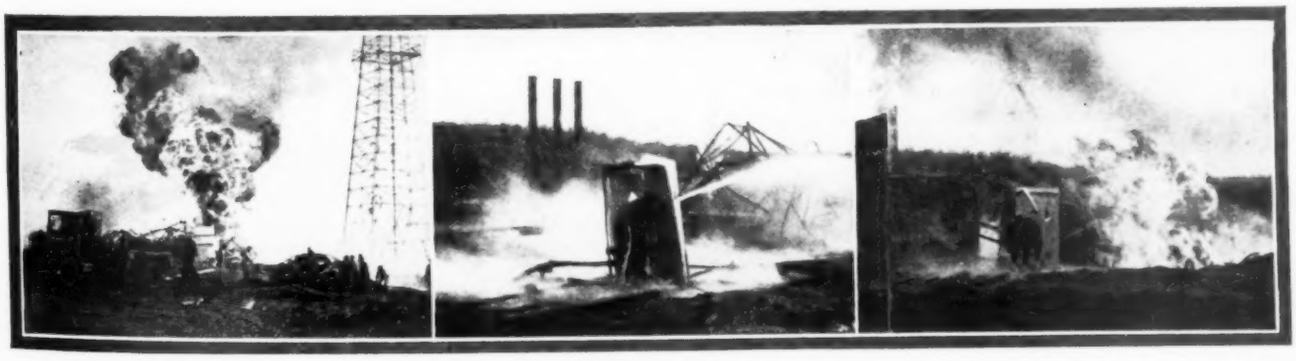
It is a credit to the Kinley brothers that the casing was but very little damaged by the shots and removal of the wreckage. This greatly aided in permitting the screwing on of the die-nipple-equipped master-gate.

There were eleven men in the rig at the time the drill pipe started coming out of the hole; one of these was in the forble tower, and miraculously all escaped injury. They were too excited to remember afterward the details of escape. Apparently several of them came close to getting hit by the drill pipe as it fell. Joe Lugar, assistant to the general superintendent of the Deep Rock Oil Corporation, was probably passing over a part of the drill pipe in his car, while part of it that had doubled back was dropping behind him and forming a loop in the spot he had been. L. N. Smith, production superintendent, ran on foot and fell twice in ditches, while the drill pipe clattered to the ground nearby.

Numerous times the two Kinleys went into the wreckage either to cut away a section, fasten a tow line, etc., and, contrary to general opinion, they never wore asbestos suits, but were clad in only ordinary work clothes. M. M. Kinley afterward stated that this was one of the worst fires he had tackled because of the condition of the derrick over the mouth of the well.

Left to right—Joe Lugar, assistant to general superintendent; Jack Smith, assistant farm boss; Paul Kennedy, assistant drilling superintendent, and Dick Ritchie, rig contractor, all of the Deep Rock Oil Corporation.

M. M. Kinley



Truck dragging part of the equipment out of the blaze.

Workmen pouring water on the wreckage.

Kinleys working where it is plenty hot.

By J. L. DWYER

THE year 1930 has, more than any other year, witnessed the introduction of many time and labor saving developments in the producing, refining, natural gasoline manufacturing and oil and gas transportation divisions of the industry.

Through the efforts of our manufacturers working in close co-operation with oil and gas company engineers, drilling has been speeded up appreciably, natural gasoline manufacturing and refining methods have been improved, yields increased, and construction and operation of oil and gas transportation systems greatly simplified.

Probably the greatest development has been in drilling, and with the advent of the larger and more powerful all roller bearing rotaries, straight hole surveying, various weight indicating and controlling devices, improved systems for handling mud laden fluid, improved bits, better tool joints, drill pipe protectors, and larger derricks, it has been possible to make an appreciable reduction in the time required to drill five and six thousand-foot wells, and also to drill holes that have a very slight deviation from the vertical.

Not a piece of equipment used on the drilling rig has escaped attention. Swivels, traveling blocks, crown blocks, and other equipment have been increased in size and weight. Traveling blocks and crown blocks have shown a marked trend toward a greater number of sheaves. Boilers using super-heaters made their appearance in drilling operations last year.

In the oil producing field similar improvements have been observed. Equipment has been made to stand the greater pressures constantly encountered. Gate valves were subjected to extreme punishment from sand-cutting and high pressures, but manufacturers met the conditions by offering valves of sturdier design and greater strength.

Separators were increased in size, capacity and efficiency and were put to new uses in the Oklahoma City field, where they were employed in the controlling of high pressure wells during the period of completion.

With the greater pressures and deeper position of the producing formations naturally came some refinements in surface equipment, as well as a change necessitated in the working barrels, sucker rods, and miscellaneous pumping materials. Air and gas lift work also witnessed some changes, and specially designed compressor cylinders capable of handling much higher pressures have been installed.

Within the past few years the trend in pipe line construction has been toward larger diameter lines, with pipe of greater tensile strength for higher operating pressures. Consequently specifications by the companies have been more rigid and the result has been greater economy in construction, fewer losses, more efficient and continuous operation.

With the trend toward larger lines came the need for deeper trenches and last year heavy machines capable of cutting a ditch more than 7 feet deep were developed. In addition to their heavy duty features for cutting deeper and wider trenches, the new ditchers embody numerous improvements affording greater mechanical efficiency.

During this period of transition the ever-present and flexible tractor has been improved in scores of ways mechanically. Its appearance has changed frequently with various types of booms and hoists for lifting and pulling heavy objects.

Various protective coatings for pipe lines were improved and some new coatings introduced in 1930. Great advancement has been made in the application methods.

Experimental work was carried on late last year in the development of air-driven ratchet wrenches to speed up the bolting of both sleeve and rubber-ring type couplings.

In station operation studied attention was given to fuel, lubrication and water cooling problems. Many installations were made in 1930 to clean fuel oil, removing water, dirt and other deleterious or abrasive material which would cause rapid liner wear.

It is interesting to note the tendency of station engineers to rely more and more upon recently developed instruments for the control of station operation and to check machinery for trouble.

In the measurement field there is an ever-increasing preference among oil transporters to measure the flow of liquids through lines with instruments rather than by manual gauging methods. Most of the progress made in gas measurement has been in connection with regulators and more attention is being given by gas companies to the proper selection of a regulator layout. There is a distinct trend toward automatic control at measuring stations.

During the past year several automatically operated stations were put into operation and a number of remote control stations also constructed.

The construction of three gasoline lines in 1930 brought about a radical change in operating practice. One line has butane fueled gas engines driving centrifugal pumps through gear increasers. Another line will use reciprocating pumps powered by oil engines and will pump through each station with a surge tank floating on the line. The third line will have a motor-driven centrifugal pumping system which will operate at 1,200 pounds line pressure.

Many millions of dollars were expended by the refining branch of the industry last year for more efficient equipment.

Most of the new distillation units are pipe stills equipped with fractionating towers, which are operated continuously and automatically. The operation of these larger units has been made possible by the use of automatic control instruments. The manufacturers of this type of apparatus have made constant progress in the development of temperature, pressure, rate of flow, and liquid level controls.

Most refiners of paraffin base lubricating oils have improved their plants and installed equipment to dewax their oils completely. The centrifuge is widely used in the manufacture of bright stocks. In a few plants special solvents or filter aids are employed. Much attention has been given to the continuous treatment of lubricating stocks, using mechanical contactors. It is believed by some authorities that this method has many advantages over the batch process. When contactors are used in the treating process, the acid sludge is removed from the oil by means of a centrifuge machine. In this way intimate contact between the oil and acid is obtained in the shortest possible time.

More attention has been given to furnace design for pipe stills and cracking units. New developments have effected increased capacities per dollar of investment and greatly improved operations. One of these developments is the installation on the furnace floor of tubes which are heated entirely by radiation.

The use of suitable alloys and metals for resisting heat, corrosion, and erosion in refining equipment, has resulted in the saving of many dollars in the industry. Co-operation between the refinery chemists and metallurgists of the valve and pipe manufacturers has produced better equipment resulting in longer and more steady service.

Many new stabilization and vapor recovery plants were constructed by refiners during the past year. In order to produce a gasoline free from vapor locking tendency, the pressure distillate and the recovered gasoline is stabilized before it is blended into the finished motor fuel.

The first commercial plant for hydrogenation of petroleum was put into operation last year, and in other ways the refiner's facilities for producing desirable products have been greatly extended. As the number and capacity of the units increase, economies in operation and cost of installation will result.

Efficient rectification or stabilization equipment is now recognized as indispensable for successful natural gasoline plant operation, since the refinery usually demands the more stable grades.

A modern natural gasoline plant is almost entirely automatic in its operation, requiring very little labor. This is made possible by the increased use of automatic control equipment. Consequently, this branch of the industry uses a great number of recording and control instruments.

The uses of liquefied propane and butanes for commercial and industrial fuels have been rapidly expanding. Many manufacturing, transportation, and marketing problems had to be solved, but this new branch of the industry is steadily progressing.

Panhandle Eastern Line Tested

ONE of the most difficult river crossings built in the construction of the Panhandle Eastern Pipe Line Company's 24- and 22-inch line from the Texas Panhandle to Indiana was the submerging of a multiple crossing in the Missouri River at Boonville, Mo. In addition to having a long cut to make in low land on one shore, the lines made a sharp climb to the surface on the opposite shore, thence through rock under a railroad and on up to the top of a steep and rocky hill to the header. A swift current in the channel likewise increased the difficulty, and tons of sand had to be dredged from under the lines to bury them to the required depth. When a further study was made of the river's characteristics, it was found advisable to build a dike on one shore to prevent the water from cutting in and ripping out the shore lines.

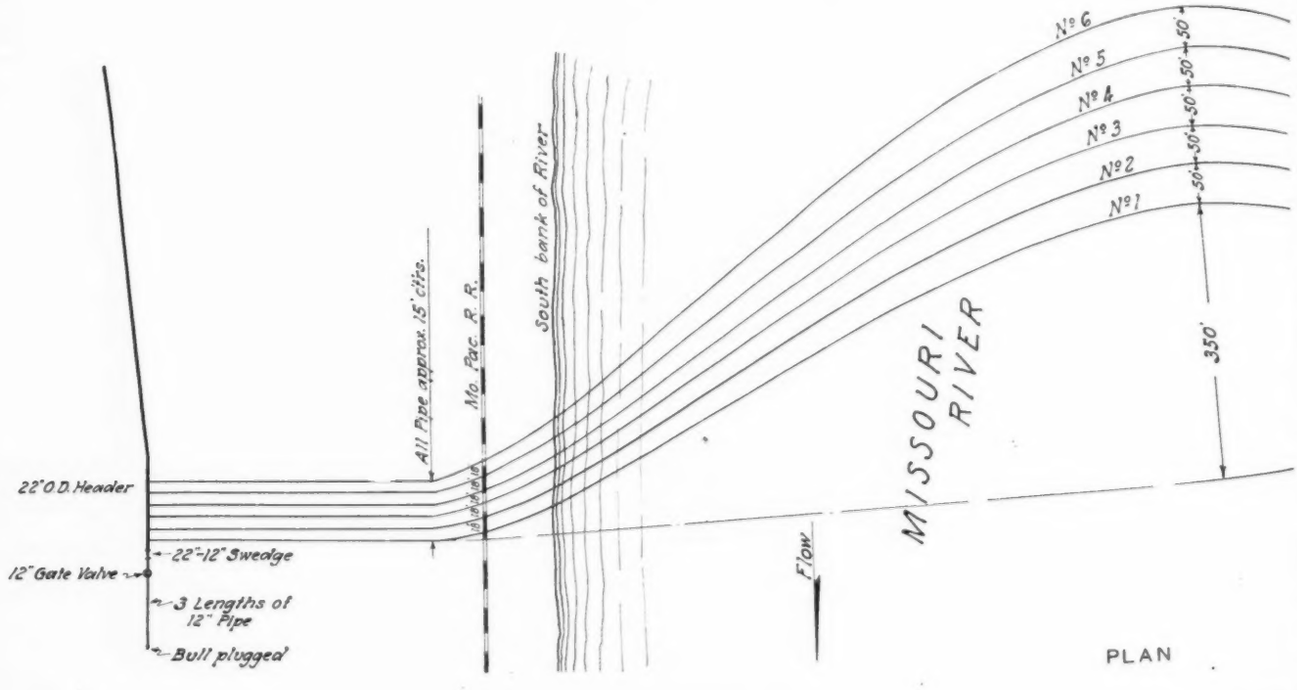
W. R. Baker, construction superintendent for Williams Bros., Inc.

Specifications called for a crossing made up with six 10-inch lines bowed 350 feet upstream, with 50-foot centers. The pipe is 48-pound river pipe in 40-foot lengths, welded together, strapped at the welds, and 1,700-pound river clamps bolted around the joints to give added strength at the joint as well as to give weight to the line. In addition to the heavy clamps, 1,300-pound clamps were placed between the heavy ones, thus spacing a clamp every 20 feet. To meet government requirements it was necessary to have a 4-foot covering over the line and each line had to be 18 feet below standard low water. The shore-to-shore lines ranged in length from 1,827 feet to 2,000 feet.

Construction work was carried on by Williams Brothers, Inc., with W. R. Baker superintendent in charge for the contracting company, while F. R. McCarthy was superintendent in charge for the pipe line company, and the engineering was under the direction of M. J. Miller, resident engineer for the pipe line company.

The method followed in crossing the river was to use an island near the north shore of the river, and directly in the line of survey, as a base for operations. The lines were welded in sections on the island and one end lashed to the end of a heavy barge to start the crossing. Two tractors on the barge, connected to stump pullers by chain drive, were employed to pull the barge across and drag the line with it. Cables were fastened to "dead men," sunk on the opposite shore, and run to the drums on the stump pullers, to pull the barge to the shore. At the same time a drag line on the island was used for the dual purpose of aiding in bowing the line upstream and reducing some of the stress on the pipe and welds by pulling the free end of the line to the water as it was dragged across by the barge.

In following this method a small fleet of varied types of floating equipment was necessary. Because of the large amount of sand to be sucked from under the lines so they could be lowered to their required depth, two dredges were used. Two tugboats were employed to move equipment and aid in pulling the lines across, as well as two barges, a derrick boat and several small power boats were required for inspectors and the transportation of lightweight material.



Skill of Construction Engineers

When equipment had been assembled and work started, a road was built to the island with logs and other available material. A short while later a rise in the river washed the road away, leaving the island cut off from the shore. One of the dredges was shoved into position and used to build a sand road across the shallow and short stretch of water at a cost considerably less than a makeshift road.

Welding equipment was moved to the island and a fast-burning rod was used to make the acetylene roll welds. The flat welds made on the low carbon seamless pipe were approximately ⅛ of an inch high and 1¼ inches in width. It required, on an average, eight rods and 40 minutes' time to make a roll weld.

When a roll weld was completed, four straps were electrically welded longitudinally to the pipe and across the weld to give added strength. Following this, the clamps were bolted tight over the weld. Each section was made up by welding eight joints of pipe together, with the clamps spaced every 20 feet, making every 40 feet of pipe going into the river weigh approximately two and one-half tons.

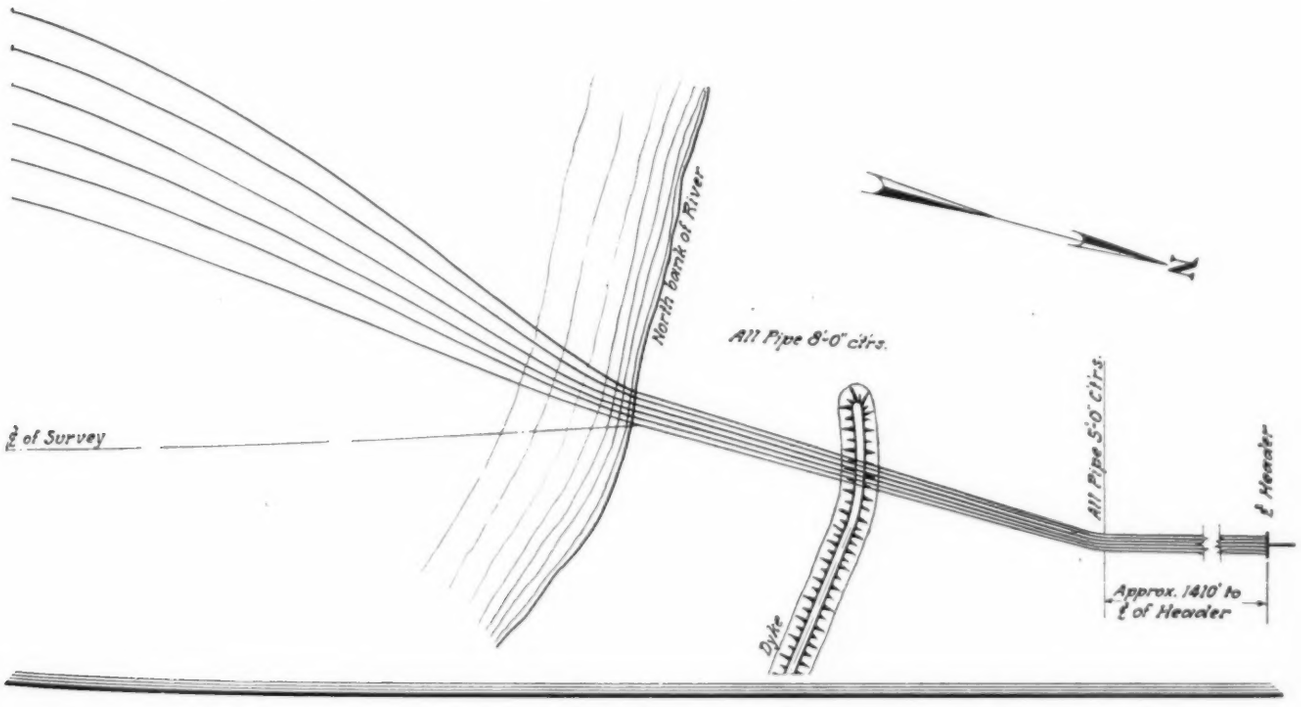
In pulling the line across the river, the 7½-ton capacity derrick boat was anchored a considerable distance upstream in the channel and as near the island as possible. It was anchored to two 6½-ton concrete blocks poured on the shore and later lowered in the river. For this part of the work the derrick boat was used to hold one end of the pulling barge in position upstream against a swift current. At the same time it could hold the barge in the event the tugboat, holding the other end, let the barge get away from it. The tug held steadfast, keeping its end horizontal upstream as the barge was pulled across. It also could hold the barge, in the event the cable from the barge to the derrick boat broke, until the second tug handling the dredges could be brought alongside and save the tug from being carried downstream with the loss of the line and possibly life.

Twelve-inch logs, 16 to 18 feet long, were buried five feet deep every 75 feet on the south shore for a distance of 600 feet up shore. These were used as "dead men" to which were attached the cables running from the stump pullers to the shore and used to pull the line across.

In starting the crossing the cables were fastened to the "dead men" the greatest distance upstream. This aided in keeping the barge upstream, and as the line was pulled in the tug shoved one end as the derrick boat pulled the other end of the barge upstream, until it was several feet above the point where the bend would be made to bow the line upstream. When this point was reached this position upstream was held until the line had been pulled about 400 feet beyond the point of bending. From this point on to within 100 feet of the shore the line was dropped gradually downstream, making a slow bend. When it was pulled this close to the shore the line was dropped sharply downstream and to the shore to the point where the line would be landed.

All of the pull was exerted by the stump pullers attached to the 20-horsepower tractors with a sprocket on the power take-off for the chain drive. Particular attention was given by the foreman on the barge to see that the tractor drivers operated their machines at a moderate speed, so as to make a slow but steady pull and to have both tractors operated at the same speed in order to exert a uniform pull on both cables and not have one handling the burden of the pull.

At the same time the drag line on the island was moving the line into the river, eliminating some of the stress on the line. Its use, however, was more important in bowing and shoving the line upstream and holding the line in the desired position as it went across. Too great a pull with the drag line, however, had a tendency to bow the line too far upstream.



Dredges sucking sand from under lines to lower them to a specified depth.

The movement of the floating equipment up or down stream was guided by an engineer on shore with a transit. Any change in position either up or down stream was made under direction of the engineer. This was done in order to have the pipe placed in the bed of the river as close as possible to the surveyed position. By calculation, and more by past experience, the movement of the boats up and down stream may be guided so that when the line is landed it will be bowed upstream the proper amount and will rest on bottom approximately on the line of survey.

To do this he had markers on the opposite shore and five-gallon oil cans were tied to each line to serve as floats and show the position of the line as it was being dragged across. Later these guide floats were used to check the exact location of the line on the river bed.

By controlling the up and down stream movement of the floating equipment in this manner the lines were more easily brought to the desired location in the river and consequently the danger in laying one line over another was reduced.

While those in charge of the work deemed it inadvisable to attempt to speed the work by pulling faster on the lines, it was their opinion that faster time could be made by having an additional derrick boat. As the work progressed the derrick boat had to be moved to new positions. This boat was anchored to heavy concrete blocks, and much time was lost each time the derrick boat was moved. With an additional derrick boat the work progressed more rapidly.

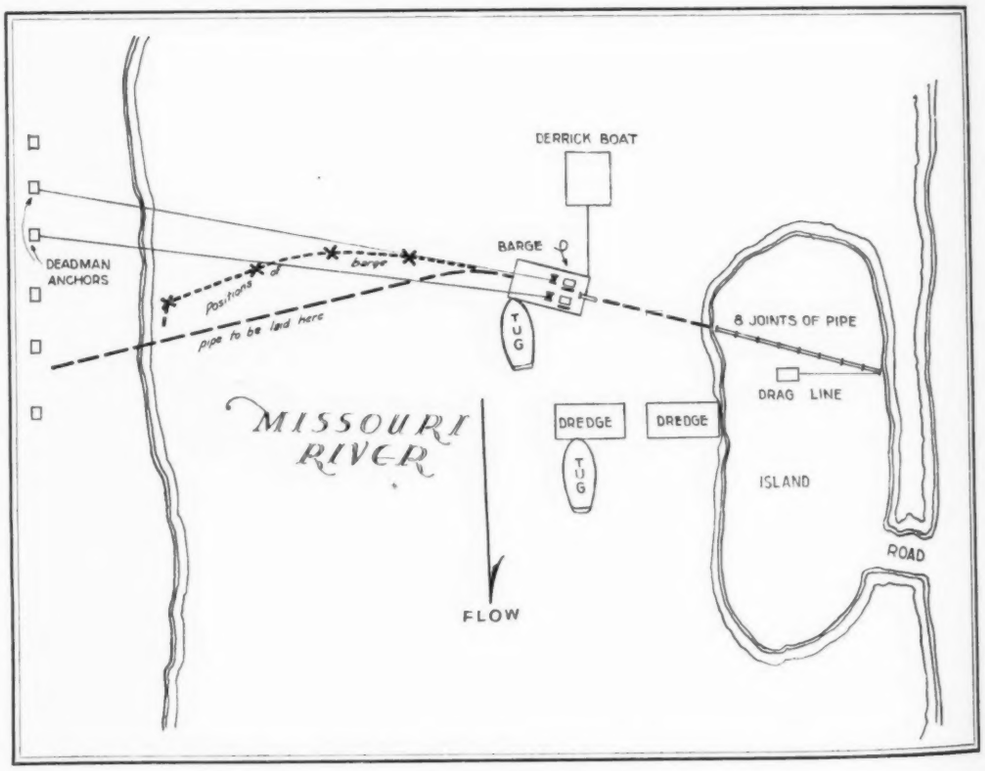
After each line was brought to the south shore the derrick boat was towed alongside the barge. By making an inverted V sling with a line on the hook of the derrick boat boom, an additional length of pipe was lined up, with the end of the line lashed to the barge. In this manner the length of pipe was held at an angle for welding and was made more rigid by throwing a line over the free end of the length and fastening it to the barge. When the last clamp had been bolted down the line was pulled over to a smaller barge and taken to the shore and made secure until tied into the proper shore line.

The dredges worked back and forth along each line, sucking sand from beneath them and discharging it on the downstream side. They moved along in one direction, lowering the line a few feet, and continued this method until the line was down the required depth. In one part of the river it was necessary to dredge down 27 feet in sand to lower the line to its required depth.

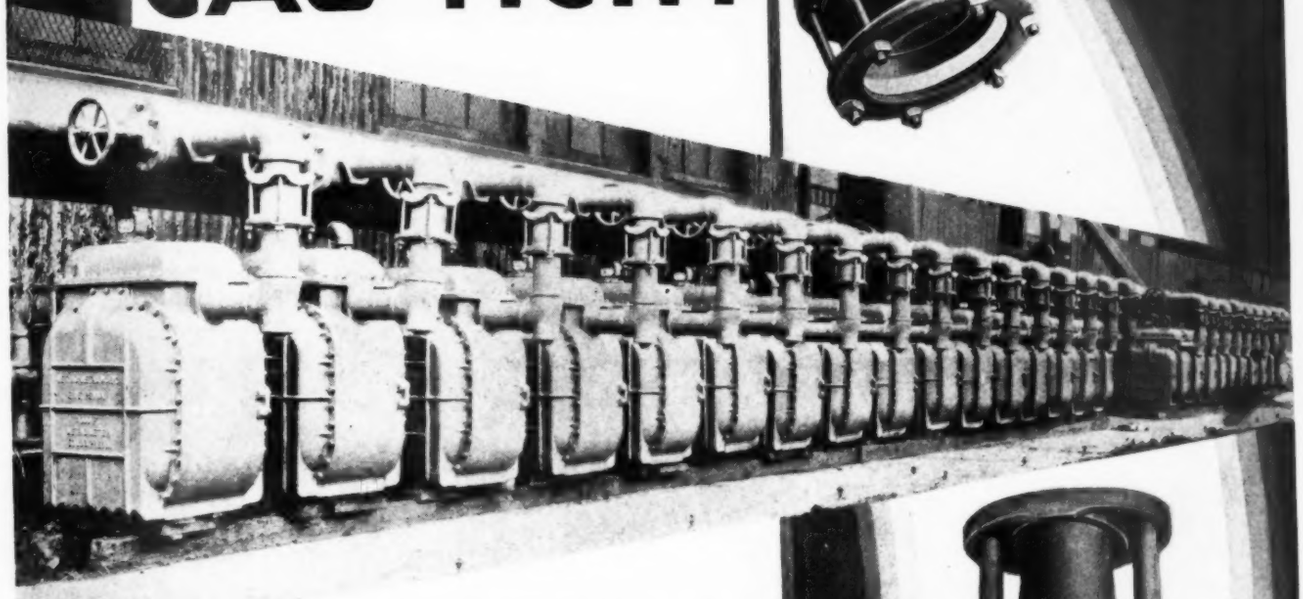
Getting the crossing from the island to the north shore was relatively easy because of the short distance and shallow water. This section was welded, then pulled and shoved across with tractors and a drag line.

On the north shore of the river the current has a tendency to cut into the bank at the point where the crossing starts down into the river. To forestall washing out at this point and uncovering of the lines, it was decided to build a dike. It will be 265 feet long and 12 feet high. The upstream end of the dike will be riprapped, mostly with old material collected upon completion of the crossing.

Over on the south shore a rail line follows the shore line of the river and is approximately 15 feet above standard low water. To get under this it was necessary to tunnel under the tracks. Considerable hard, flinty rock was encountered, making it necessary to resort to frequent but



METER CONNECTIONS must be GAS TIGHT



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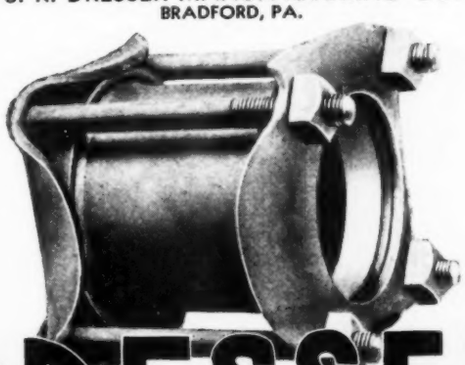

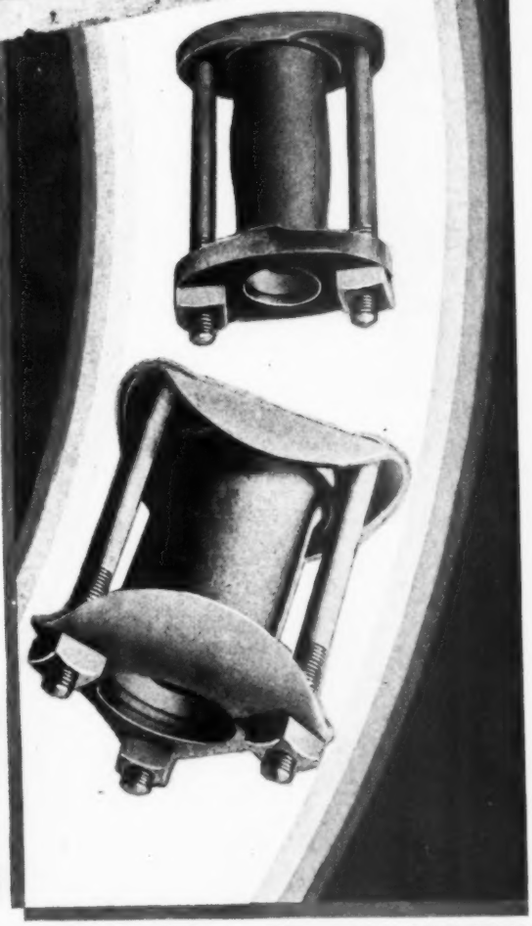

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light blasting. Going on up alongside the steep and rocky hill was equally difficult.

By following this method of crossing the river the contractors put all six lines across without the loss of a line and without breaking a single one. Once a near disaster imperiled one line after it had been pulled well beyond the middle of the channel. The cable from the derrick boat to the barge snapped, permitting the end of the barge with the pipe line to swing free downstream. The tugboat lashed to the other end of the barge moved forward under full power, checking the barge on its half-spin. At the same time warning signals were sounded from both the tug and the derrick boat, calling the other tug to the scene to shove on the free end of the barge, pushing it and the line back upstream and holding it there until a new cable could be carried from the barge to the derrick boat. The second tug, a steam-powered craft, left a trail of smoke behind it as it was maneuvered into position. When both tugs were in position their stern and side wheels churned the water to a murky froth as the barge was pushed back into position and held there until another line was extended to the derrick boat.

An interesting engineering problem developed at about the halfway mark of the job, which will probably delay final completion several months. It was discovered, after several lines were across the river, that the sand and mud on the walls of the south bank was not as deep as was indicated. It was later found that the wall from standard low water mark to the bottom of the channel was solid rock. This meant it would be impossible with ordinary methods to get a four-foot covering over that section of the crossing sloping approximately 100 feet out from the shore to the bed of the channel.

It is probable that a trench will be excavated in the side wall with air drills and a split chisel. Government requirements can be satisfied by placing the lines in 2-foot trenches belled sufficiently to accommodate the river clamps. With the lines in that size trench there would be no danger of dragging anchors fouling or grabbing the pipe lines.

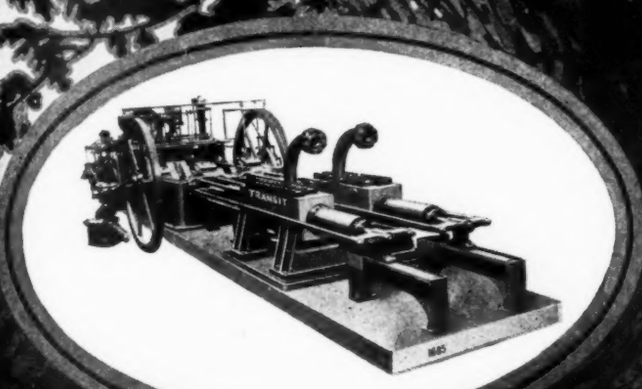
Field-made header.

To do this work a diver will probably be employed to guide the drill in cutting the holes around the side and from the top of the trench and then chipping out with a split chisel.

It is interesting to note that a safety campaign was carried on during the entire construction job. Direction of this work was done mostly by the foremen, who not only were responsible for good workmanship, but at the same time were constantly on the alert to see that the work was done in a manner to promote safety. The result of the campaign was that the project was completed with a minimum of injuries, and these were only of a minor nature.

General view of crossing from north shore.

STRONG *and* STURDY



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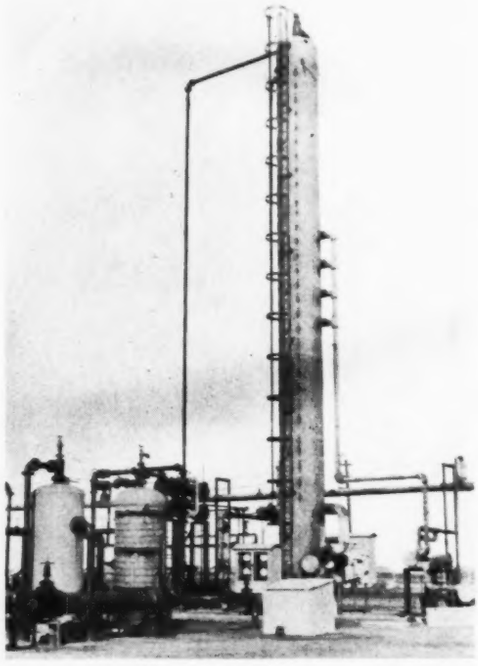
Van Gasoline Plant Embodies Latest Engineering Features

By F. R. STALEY

THE natural gasoline plant in the Van pool, Texas, was constructed and is operated by The Pure Oil Company for the Van Joint Account, which represents five operating companies in this field. The present capacity of the plant is nearly ten million cubic feet of gas per day. It was built in record time, requiring less than two months for its erection. Plant operation began the middle of last September.

The engineering features and the equipment installed are representative of the latest developments i the natural gasoline industry. Efficiency and economy result from the extensive use of automatic control instruments and devices wherever possible. Recording instruments are used to register temperature pressures, and rates of flow in the plant operation. The engineers laid the plant out so that additional units can be installed whenever it is necessary to increase the throughput, or so the stripped gas can be put back for repressuring at a future date.



Stabilization unit, Pure Oil Co. natural gasoline plant, Van, Texas.

The Van field has over 150 producing wells at the present time. Due to proration, production is greatly curtailed. The potential production is 550,000 barrels per day. A recent completion in the south end of the field proves the productivity of a large acreage held solely by The Pure Oil Company.

The gas from the field gathering system enters a 24-inch line to the plant. A master flow meter is installed in this line which measures the total gas input. It is a recording meter and is checked against the smaller capacity meters on each well. The gas is first cleaned by two scrubber towers before it enters the compressors.

The compressor installation consists of fourteen 200-horse-power two-stage gas engine-driven compressors, discharging the gas under 300 pounds pressure. Separate accumulators for the raw gasoline from each unit are installed outside the compressor room.

General view of Van gasoline plant.

Stabilization Unit

All of the raw gasoline from the accumulators is fractionated in a high pressure bubble type stabilizing unit. This operates at about 210 pounds per square inch pressure. The unit operates entirely automatically. Recording control instruments are used. All of the gasoline produced in the plant is stabilized to 96 per cent recovery.

The plant is producing about 24,000 gallons of stable gasoline per day. The average gasoline content of the gas to the plant is about three gallons per 1,000 cubic feet. The gasoline is sweet and noncorrosive, requiring no chemical treatment.

The finished gasoline storage consists of six 10 by 48 feet horizontal tanks. The gasoline is shipped to The Pure Oil Refinery at Smith's Bluff.

Two redwood cooling towers are used in the plant. Water is pumped by means of electrically driven centrifugal pumps. The water level in the hot well is controlled automatically by means of a float control operating a gate valve on the discharge side of the pumps. One tower is used to cool the engine jacket water and the other for the gas coolers.

Steam Still

A horizontal type steam still, automatically controlled, is installed in the plant for distilling any off-colored or drip gasoline.

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SIGNAL HILL, LONG BEACH, CALIFORNIA—PHOTO BY MR. A. E. EVANS

for the plant and for the employees' cottages is generated by means of two 125 K. W. generators, each driven by a 190-h.p. gas engine.

Boiler House

The steam boiler installation consists of two 100-h.p. boilers. These are gas fired and automatically controlled as to water level and pressure.

Water Supply

A water station for operations in the Van field consists of a 55,000-bbl. tank and electrically driven pumps, which take water from the Neches River. Three water wells were drilled. Drinking water is filtered and treated with chlorine.

Personnel

The plant is operated by four men on each of three shifts. S. W. Barnhardt is superintendent of the plant, and Roy Douglas is chief clerk.

A filling station is maintained for serving trucks and automobiles. It is supplied with stabilized gasoline from the gasoline plant.

The oil from the Van field is pumped to the Smith's Bluff refinery through a 10-inch line approximately 140 miles long. The line is operated by the Pure-Van Pipe Line Co. A 550,000-bbl. storage tank farm is located at Van. The Humble Pipe Line Co. recently completed a line to Shreveport. It will transport about 15,000 barrels of Van crude per day.

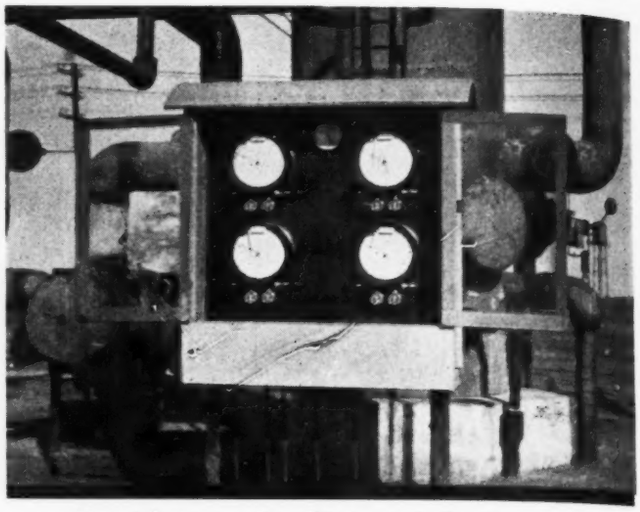
Analysis of Van Crude

Analysis and yields from Van crude are as follows:

Gravity	34.9 A. P. I.
Color	Brown
Sulphur	0.94 %
B. S. & Water	0.2 %
Pour	Zero

Approximate Yields

Gasoline (420 E. P.)	28.12 %
Kerosene, 44 A. P. I.	5.84 %
Gas Oil, 38-40 A. P. I.	21.83 %
Wax Distillate 23 A. P. I.	17.55 %
Fuel 12 A. P. I.	24.70 %



Control instruments, Pure Oil Company's Van, Texas, plant.

The kerosene had an end point of 518 degrees F. and 136 degrees F. closed cup flash.

The gas oil had a viscosity of 55 Saybolt at 100 degrees F. and a 35 degrees F. pour-point.

Wax distillate viscosity is 300 at 100 degrees F., 310 degrees F. flash, and 360 degrees F. fire.

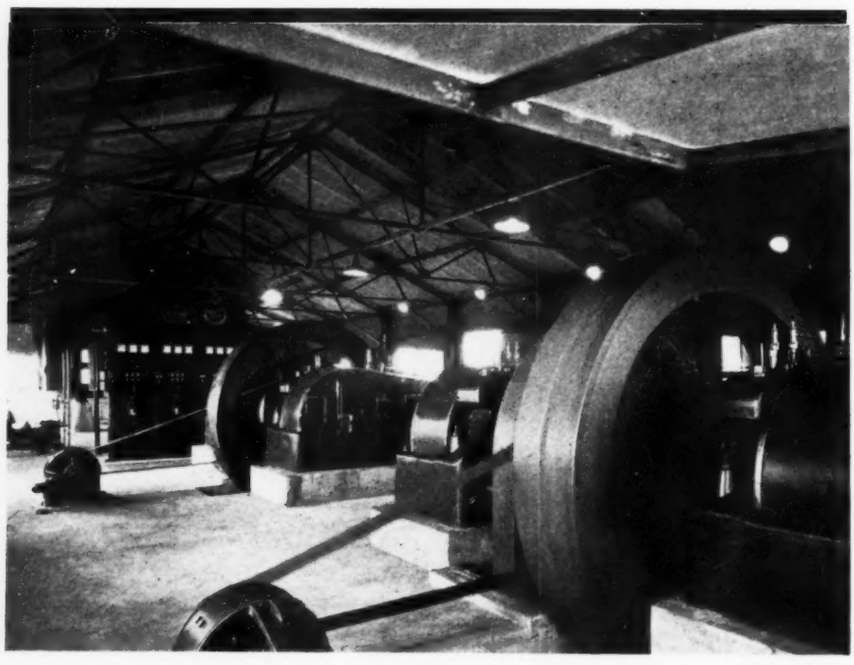
Fuel oil flash (Pensky-Martin) 300 degrees F. and 1,285 furol viscosity at 122 degrees F.

The analysis of the crude shows that it is mixed base containing a wax distillate cut which can be refined and dewaxed to produce lubricating oil. It contains a considerable percentage of asphalt, which is indicated in the yield of low gravity fuel oil.

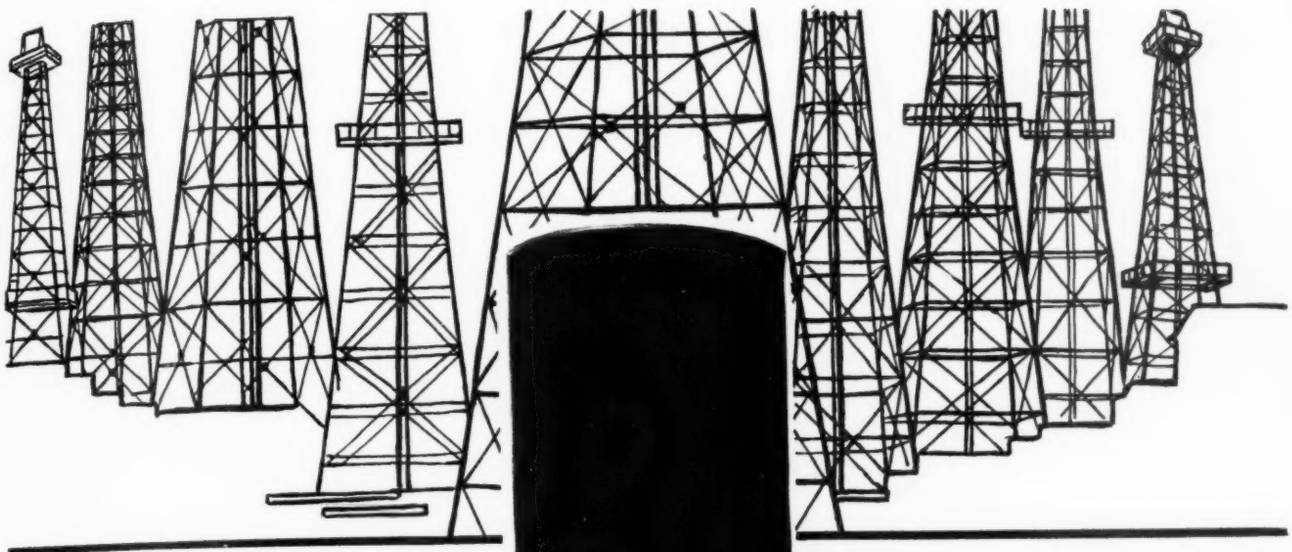
The various buildings in the gasoline plant for housing the compressors, boilers, pumps, etc., are constructed of sheet metal with steel framework and concrete foundations. There are fifteen cottages for employees and an executive cottage on the lease. In addition to these buildings there are three bunkhouses, a dormitory, a mess hall and a twenty-two-room office building. A warehouse, a truck repair shop and a geological laboratory are maintained.

The general appearance of the properties in the Van field is exceptionally good and indicates that much care and attention has been given to this phase in the development. Lease equipment and tankage are all painted, generally with aluminum paint. The number of buildings for stores and office use in the town of Van have steadily increased, giving it the appearance of a real town.

Since the Van field is one of the first and largest in the country to be developed under unit operation from its very inception, the maximum utilization of gas is possible, and consequently its progress will be watched with much interest by the entire industry.



Interior of electric power plant at Van.



Strength Safety

SAFETY in the hole is of paramount importance in oil well drilling, and, where slotted pipe is used, depends largely upon the strength of such pipe.

Kobe Heat-Treated Screen Casing provides the highest possible factor of safety in the hole, due to its superior strength which results from our exclusive and patented method of slotting and heat-treating the metal adjacent to the slot.

This superior strength has been definitely established by many cross-bending, crushing and other tests which we have made almost continuously since Kobe pipe was first developed.

If you want to know the facts regarding the strength of screen casing, send for our latest booklet, "A Higher Factor of Safety In The Hole." Mailed on request to any responsible company or individual. No obligation involved.

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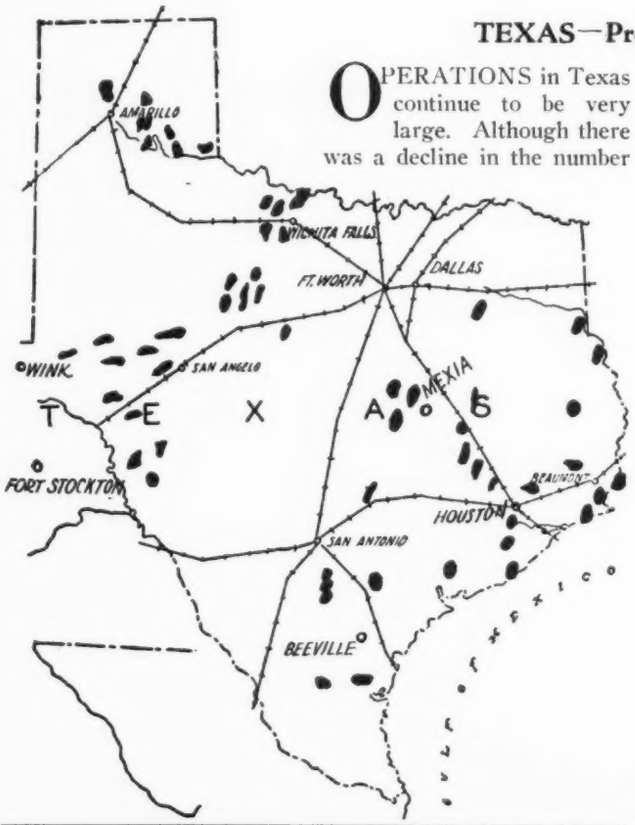
Latest Activities *in the* Oil Fields*

TEXAS—Production, 1929—299,054,250 Barrels



OPERATIONS in Texas continue to be very large. Although there was a decline in the number of drilling permits there was no drop in the number of drilling wells. The state has 895 drilling wells, 225 rigs, and, during the past month, had 323 completions and 345 new locations staked. Both rotary and cable tools are operated in this state.

Gray County, Texas Panhandle, is having a revival of activity with the discovery of oil production in the Robert Sullivan area.

A review of the most active fields in the state for the past month is as follows:

	POOLS			Gray
	Van	Pettus	Refugio	County
Number of Permits	22	.....	16	20
December Completions	12	4	8	12
Number of Rigs	1	4	1	19
Number Drilling Wells	27	4	28	35
Gravity of Oil	35	35 to 48	26	42
Depth of Production	2600	4000	6500	2990
Type of Tool Used	Rotary	Rotary	Rotary	Rotary
Number Casing Strings	2	2	3	2

CALIFORNIA

Production, 1929—292,321,700 Barrels

California has 409 drilling wells and 67 rigs. There were 83 completions last month and 43 drilling permits.

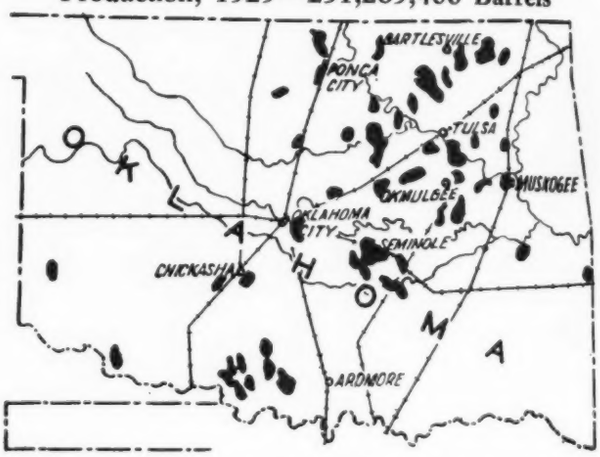
Playa Del Rey continues to be the most active field. However, it is showing a decline in operations. Heavy proration restrictions are holding down California operations to a very large degree.

Following is a review of the active fields:

	Playa Del Rey	Long Beach	Kettleman Hills	Elwood
Number of Completions	34	14	.....	2
Number of Drilling Permits	33	23	.....	1
Number of Drilling Wells	84	59	15	4
Depth of Production	6000	7000	8300	3500
Gravity of Oil	23	26	60	37
Type of Tool Used	Rotary	Rotary	Rotary	Rotary

OKLAHOMA

Production, 1929—251,269,400 Barrels



Drilling operations in Oklahoma showed a tremendous decline the past month, due to increased completions and the shutting down of many drilling wells. There are only 262 drilling wells in the state at this time, with 203 tests now shut down. This brings operations in Oklahoma to the lowest point of activity since the big boom commenced in the Greater Seminole area in 1927.

A summary of the state and its two most active fields for the past 30 days follows:

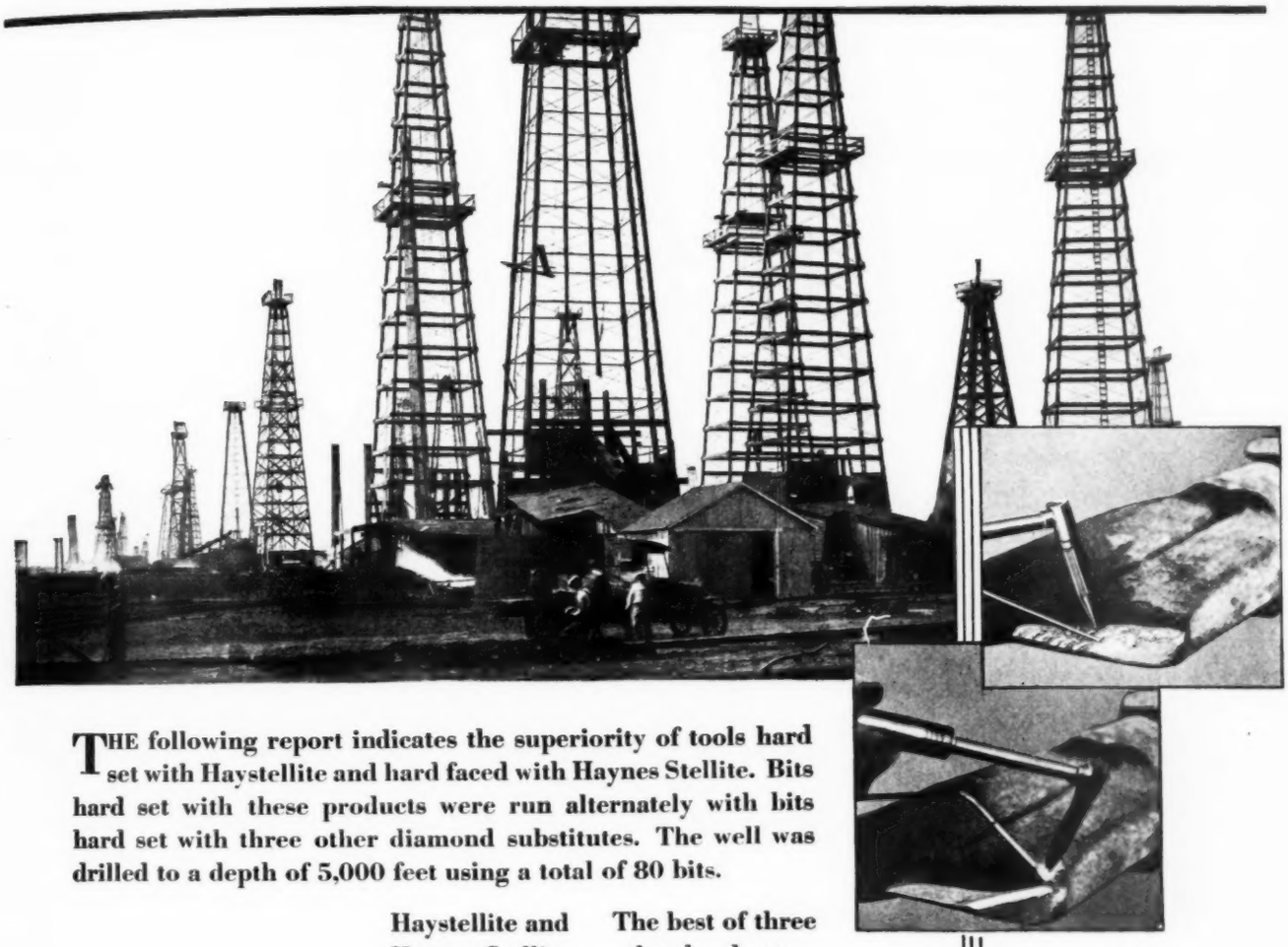
	Entire State	Oklahoma City	West Asher
Number of Permits	124	11	2
December Completions	202	42	3
Number of Rigs	68	9	4
Number Drilling Wells	262	83	4
Gravity of Oil	36	39	37
Depth of Production	Varies	6400	3500
Type of Tool Used	Cab.-Rot.	Rotary	Rotary
Number of Casing Strings	.....	3	2

The gravity of the oil varies in the state, but averages close to 36 degrees Baume.

* All statistics as of January 1st.

● Denotes oil and gas fields.

BITS HARD SET WITH HAYSTELLITE
are creating new performance records



THE following report indicates the superiority of tools hard set with Haystellite and hard faced with Haynes Stellite. Bits hard set with these products were run alternately with bits hard set with three other diamond substitutes. The well was drilled to a depth of 5,000 feet using a total of 80 bits.

	Haystellite and Haynes Stellite	The best of three other hard sets
Average footage per bit	**71.4**	**58.8**

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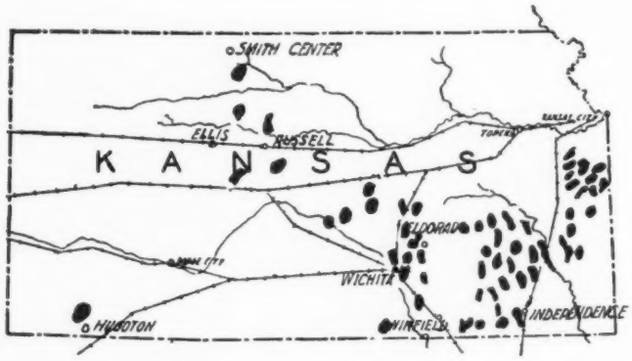
KANSAS— Production, 1929—40,991,450 Barrels



The state of Kansas has 89 drilling wells, which is a very large drop in activity. The past 30 days saw the issuing of 50 drilling permits. The state has 42 rigs and 44 wells shut down. There were 66 completions made last month. McPherson County is having a revival of drilling as the result of new discoveries, and is carried in the active field report this month, which is as follows:

	McPherson County	East-borough	Hugo-ton
Number of Permits	19	15	8
December Completions	9	4	1
Number of Rigs	18	5	1
Number Drilling Wells	18	5	5
Gravity of Crude	37	36	gas
Depth of Production	2900-3400	2900-3250	2750
Type of Tool Used	Cab.-Rot.	Cab.-Rot.	Cab.-Rot.
Number of Casing Strings	2	2	2

ARKANSAS

Production, 1929—25,372,700 Barrels

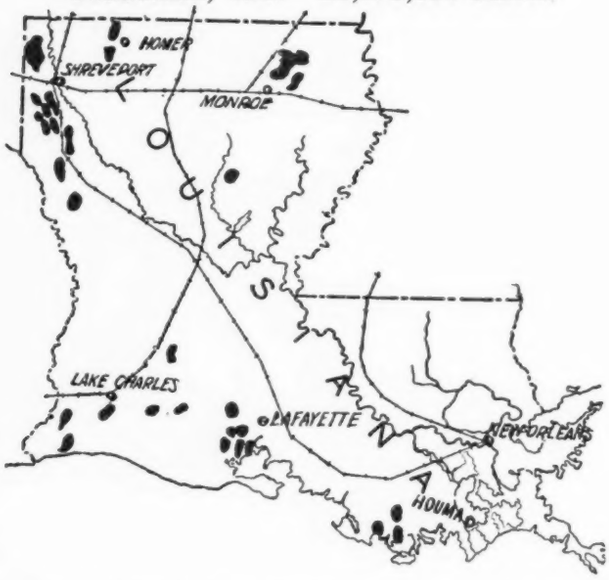
Operations in Arkansas during the past month were as follows: 5 completions, 8 drilling permits, 5 rigs, and 48 drilling wells.

Frequent heavy gas pressures and soft, cavey formations are found in this state. Rotary tools are used for boring the holes.

Activity in the state is the lowest in years, with no active pool being developed.

LOUISIANA

Production, 1929—21,172,000 Barrels



Fifty-one new drilling permits were issued in Louisiana the past 30 days. During this time there were 66 wells completed. The state has 134 drilling wells and 44 rigs. Rotary tools are used.

Mississippi, adjoining Louisiana on the east, continues to increase in activity and is one of the most promising wildcat states in the Union at this time. This state now has 29 drilling wells and 10 rigs. During the month 5 wells were completed. Operations in Mississippi center around Jackson, where several gas fields have been found.

Alabama, another nearby state, now has 2 rigs and 3 drilling wells that are seeking oil production.

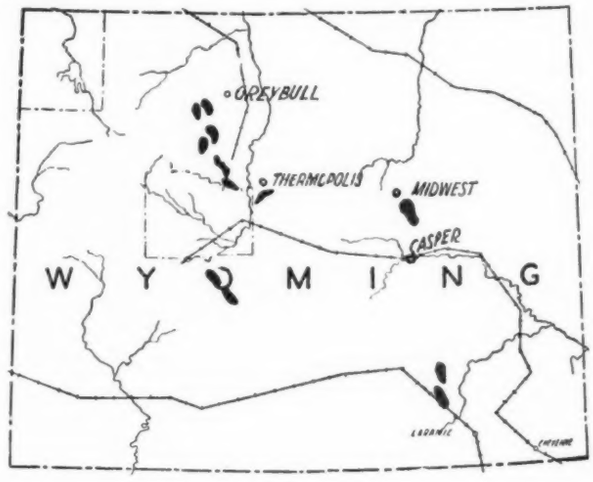
● **Denotes oil and gas fields.**

WYOMING

Production, 1929—19,388,000 Barrels

Wyoming has 108 drilling wells and 20 rigs. The past month it had nine completions. Both rotary and cable tools are used in this area, with the cable tool type the most common.

Several wildcat tests are now holding the interest of operators.



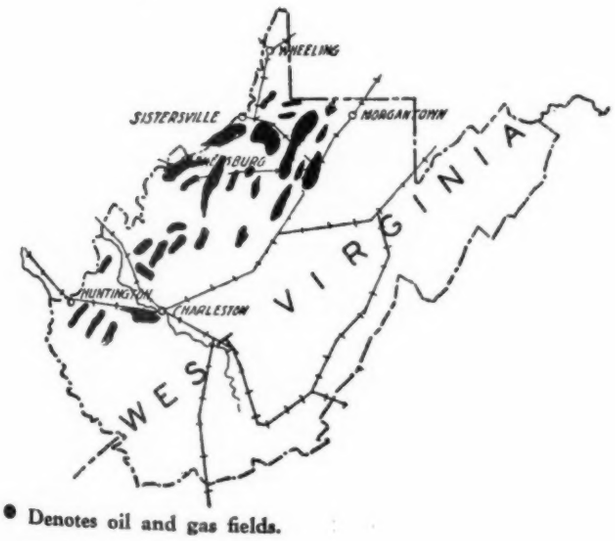
NEW YORK
Production, 1929—3,345,000 Barrels

PENNSYLVANIA
Production, 1929—11,905,000 Barrels

Pennsylvania continues to be pretty active, but a considerable portion of the activity is now being completed. Last month there were 63 completions, all drilled with cable tools. The state also has seven rigs and 54 drilling wells. New York state, where a gas field has been developed just across the Pennsylvania line, had but 4 completions.

ILLINOIS
Production, 1929—6,304,000 Barrels

Illinois is showing a steady drop in the number of operations. The past 30 days the state had 13 completions, and but 2 rigs and 19 drilling wells are being carried on scout reports. Drilling depths are shallow and cable tools are depended upon for doing the drilling.



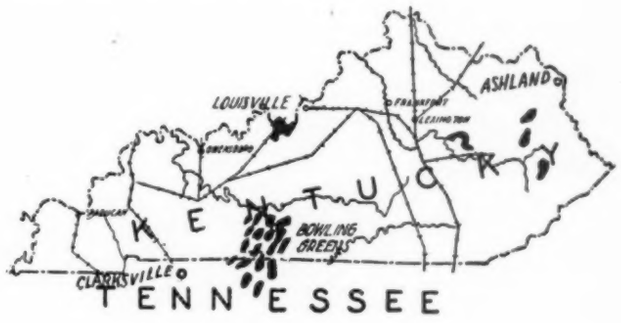
● Denotes oil and gas fields.

KENTUCKY
Production, 1929—7,776,000 Barrels

One hundred seven tests are being drilled in Kentucky according to a late survey, and there are 16 rigs. Last month this state had 90 completions, which was a large portion of the number drilling.

Tennessee is showing very little activity. There are but 17 drilling wells and no other activity in the state.

Cable tools are used in these two states.

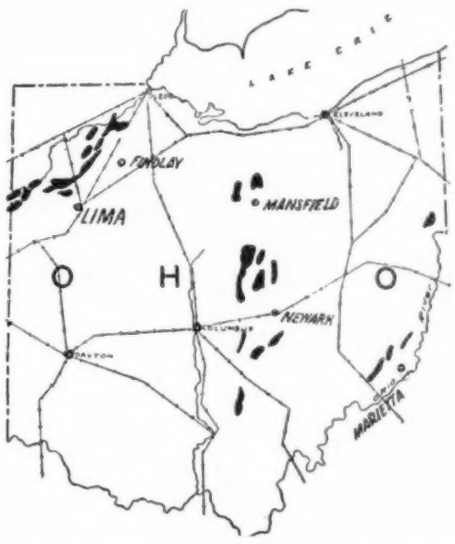


TENNESSEE
Production, 1929—19,000 Barrels

OHIO
Production, 1929—6,708,000 Barrels

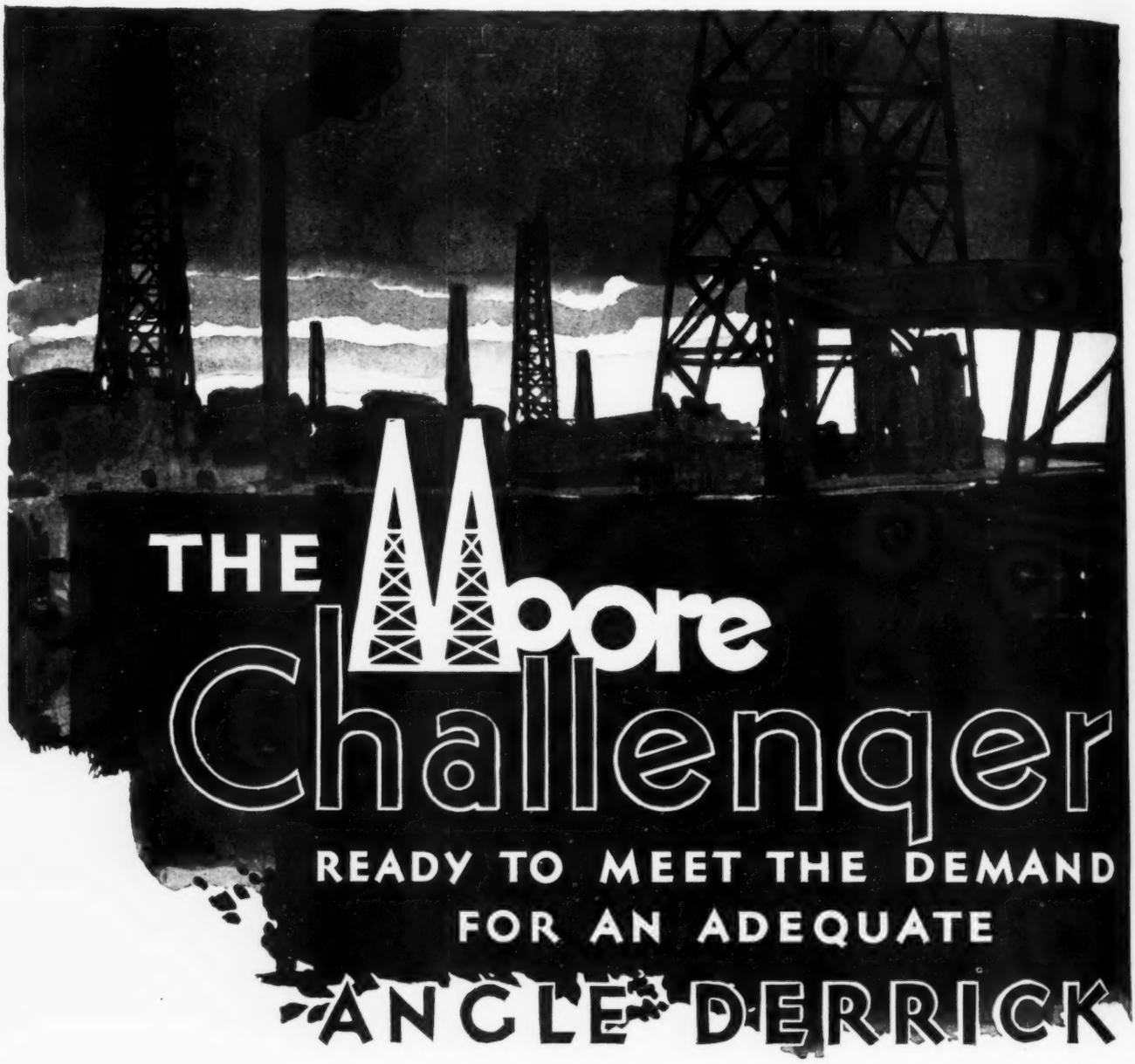
Ohio continues to lead by a wide margin the central Middle states in activity. Last month it had 183 completions. It has 240 drilling wells and 58 rigs. Central Ohio is the most active sector of the state. Eighty-seven completions, 35 rigs and 141 drilling wells are reported from this area.

Ohio tests are drilled with cable tools.



WEST VIRGINIA
Production, 1929—5,587,000 Barrels

West Virginia has shown an increase in activity. A total of 77 tests were finished last month, when 30 rigs and 80 drilling wells were on the active list of operations. The wells are drilled with cable tools.



By the use of silicon steel leg sections, together with the design of bracing and the balanced construction which have made the Champion Derrick famous for strength and rigidity, Moore offers an angle derrick which fully satisfies every requirement for a structure of this type. The Moore Challenger conforms to A. P. I. standards and the important features of interchangeability, characteristic of Moore design, have been utilized. Extensive field service has demonstrated the strength and economy of the Moore Challenger.

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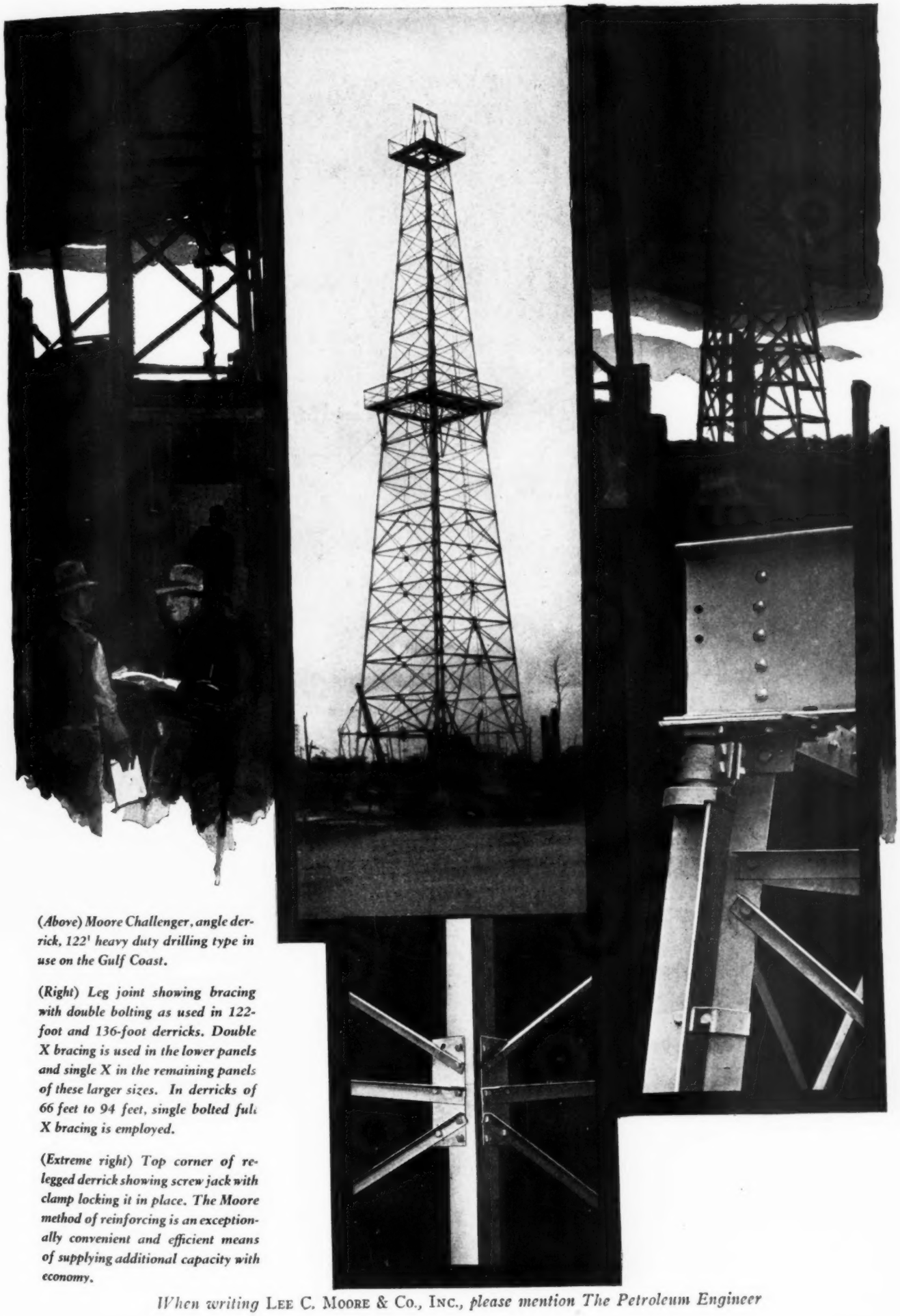

(Above) Moore Challenger, angle derrick, 122' heavy duty drilling type in use on the Gulf Coast.

(Right) Leg joint showing bracing with double bolting as used in 122-foot and 136-foot derricks. Double X bracing is used in the lower panels and single X in the remaining panels of these larger sizes. In derricks of 66 feet to 94 feet, single bolted full X bracing is employed.

(Extreme right) Top corner of re-legged derrick showing screw jack with clamp locking it in place. The Moore method of reinforcing is an exceptionally convenient and efficient means of supplying additional capacity with economy.

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NEW MEXICO
Production, 1929—1,395,000 Barrels

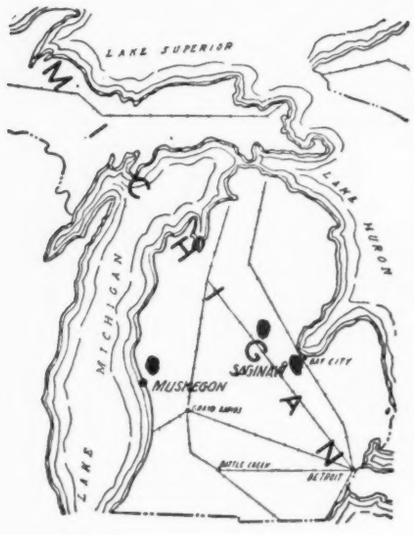
Activity in New Mexico is slowing up to a very large degree, due principally to the efforts of companies to delay drilling as much as possible in the Hobbs area.

The state had but 20 completions last month, of which 19 were in the Hobbs pool. The state has 13 rigs and 72 drilling wells. Hobbs, the only active field, had 10 new locations staked during the month, and at present has five rigs and 26 drilling wells.

Rotary tools are used by contractors at Hobbs and in other parts of New Mexico, with the exception of a few tests being drilled with cable type tools.

The producing horizon of the Hobbs field is about 4200 feet. Three strings of casing are usually set. Upper sand, carrying heavy pressures, demands that attention be given to rotary drilling mud, which is the hardest drilling problem in the field. Elaborate mud-handling plants and systems are used in the pool to secure the best drilling fluid.

MICHIGAN
Production, 1929—4,500,000 Barrels

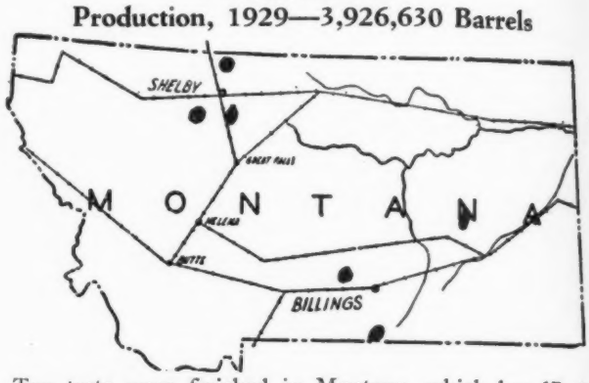


● Denotes oil and gas fields.

The oil fields of Michigan had 34 completions last month, 60 rigs and 99 drilling wells. Most of the drilling here is accomplished by the use of cable tools.

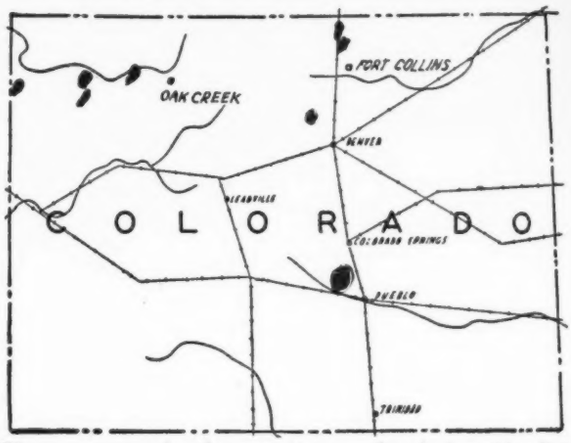
Operations in the state are showing a slow decline, and until something new is opened there is not expected to be any increase.

MONTANA
Production, 1929—3,926,630 Barrels



Ten tests were finished in Montana, which has 17 rigs and 75 drilling wells. Utah, a neighboring state, had two completions. There is one rig and 19 drilling tests in Utah. Both rotary and cable tools are used in these states, with the latter predominating.

COLORADO
Production, 1929—2,372,100 Barrels



There were only three tests completed in this Rocky Mountain state, which has 14 rigs and 76 drilling wells. Rotary tools do most of the drilling in this region, but cable tools are also used on shallow wells.

INDIANA
Production, 1929—977,000 Barrels

A continuation in the decline of activity in Indiana saw only 17 completions during the month of December. The state had only two new rigs and 39 drilling wells at the end of that month.

Cable tools are depended upon entirely for the drilling of hole in this state, where the producing horizons are quite shallow.

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Why Axelson Rod Stock is the Best Steel Mills Produce

AXELSON rod stock is manufactured in accordance with the best alloy steel mill practice. Exhaustive laboratory tests have always determined the source of this stock:

In chemical analysis the carbon range of the steel is never more than three points plus or minus from specification, whereas standard practice allows a ten-point range. Cast in corrugated ingot molds having hot tops, expansion and contraction is permitted without the danger of cracks developing. Hot tops eliminate pipes in the bloom. After pouring, the molds are not moved for two hours, allowing full time for the metal to solidify.

Ingots are re-heated in "soaking pits" before rolling, then reduced to 11"x12" bloom and sampled for analysis check. The blooms are then pickled and chipped for any defects, re-heated, rolled to 6"x6" billets by the same process, insuring the most uniform product. Axelson rod stock is rolled from the 6"x6" billet on a 12" mill, assuring a distinct grain refinement not possible to obtain in a smaller billet. In reducing the 6"x6" to ¾" bar, Axelson sucker rod steel actually passes through twenty-two sets of rolls, producing a much better grade of steel than if rolled from smaller billets passing through only eight or ten rolls. Two samples are taken from each ¾" bar after it comes from the 12" mill and are then checked for size, roundness and any surface seams. The rod is softened in the hot bed to comply with specified physical requirements. This also serves to relieve any internal stresses or strains induced by rolling or any contraction which has occurred in cooling.

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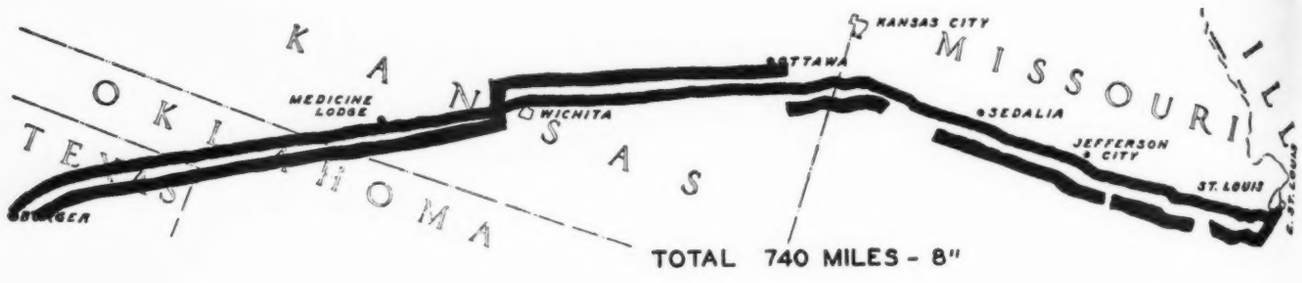
Progress of Major Pipe Line Work

GREAT LAKES PIPE LINE CO.

AT the start of the new year, pipe line construction is maintaining much of the pace which marked 1930 as the greatest year in pipe line history. The Great Lakes Pipe Line Company's construction program is moving along speedily and over the half-way mark. This line is being built with 8-inch and 6-inch pipe with welded joints. Contract was recently awarded to the Southwestern Construction Co. to build the 8-inch section south from Barnsdall to Tulsa and the 4-inch section to Muskogee.

The line has been tested and accepted from Ponca City to Kansas City, Mo. The first seven of the Diesel engine reciprocating pump stations on the line are approximately 80 per cent complete and those stations between Ponca City and Kansas City will probably be completed within a short period, permitting that section of the line to go in service.

PHILLIPS PIPE LINE CO.



Phillips Pipe Line Co. has only a few weeks more of work on its 740-mile, 8-inch gasoline system from the Texas Panhandle to St. Louis, Mo. Construction of this solid welded line is being carried on by Kelly, Dempsey & Co. The station construction program is going forward in step with the line construction.

The line from Pampa to Wichita, Kan., has been tested with water and within a short while gasoline will be pumped with centrifugal pumps driven by gas engines to that point. As rapidly as the line can be tested on east it will go in service. Right-of-way buyers are securing right-of-way for 53 miles of 6-inch which will be extended north from the main line to Kansas City, Mo. Construction on the lateral may be started within the next 30 days if weather conditions are not too severe. The Phillips company has purchased terminal facilities in Kansas City.

Indicates completed portion of line.
Indicates proposed route of line.

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GULF PIPE LINE CO.

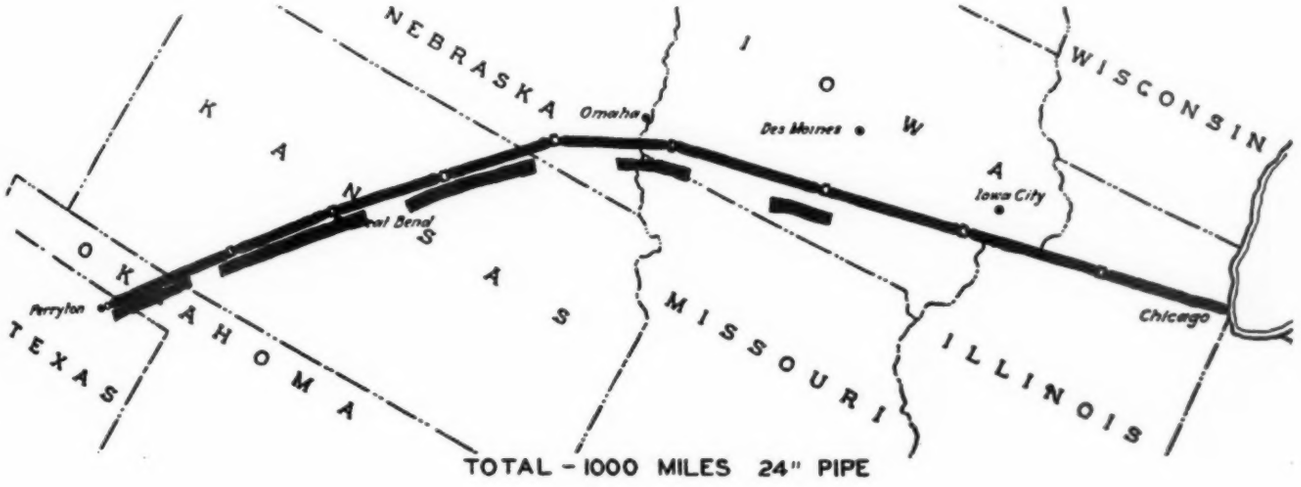
Gulf Pipe Line Co. of Pennsylvania completed its 760-mile 10-inch welded oil line running from Jenks, Okla., to a point near Spencerville, Ohio, during the middle of December. The remaining construction work on this project is a 49-mile, 8-inch lateral running south to Cincinnati. Work on this line probably will not be started until March. Alternate stations on the line with Diesel engines driving reciprocating pumps went on continuous operation the latter part of December. The line intersects an eastern pipe line at Spencerville for movement of crude oil on east.

EAST SUSQUEHANNA PIPE LINE CO.

In the East, Susquehanna Pipe Line Co., Sun Oil Co. subsidiary, is in the completion stages of its 6-inch and 8-inch welded gasoline carrier. This line will be a high-pressure carrier and will have ten 6-stage, motor-driven centrifugal pumps in its stations. The line will be operated at a pressure of around 1,000 pounds.

Indicates completed portion of line.
Indicates proposed route of line.

CONTINENTAL CONSTRUCTION CORP.



The major project of the group, Continental Construction Corporation's 24-inch gas line coming out of the Texas Panhandle and terminating at Chicago, Ill., probably will not be finished until next fall. Specifications on this combination welded and coupled gas transmission system are being followed closely with the view of getting the type of construction desired rather than have the line completed speedily.

PANHANDLE-EASTERN PIPE LINE CO.

The Panhandle Eastern Pipe Line Co. is rapidly closing the gaps in its 24- and 22-inch combination welded and coupled, 175,000,000 cubic feet capacity gas transmission system from the Texas Panhandle to the Illinois line. This line will be extended on to Indianapolis with 22- and 20-inch pipe. Difficulties in obtaining right-of-way have held up the construction program through Illinois, but these troubles will probably be straightened within the next 30 days, permitting construction to proceed.

Columbia Gas & Electric Co. owns this line jointly with the Missouri-Kansas Pipe Line Co., who initiated the project, and it is rumored the line is to be built on east to tie into the Columbia's system.

Indicates completed portion of line.
Indicates proposed route of line.

Photos taken on the SINCLAIR PIPE LINE Company's 12 inch line laid by Truman-Smith over Oklahoma's roughest country.

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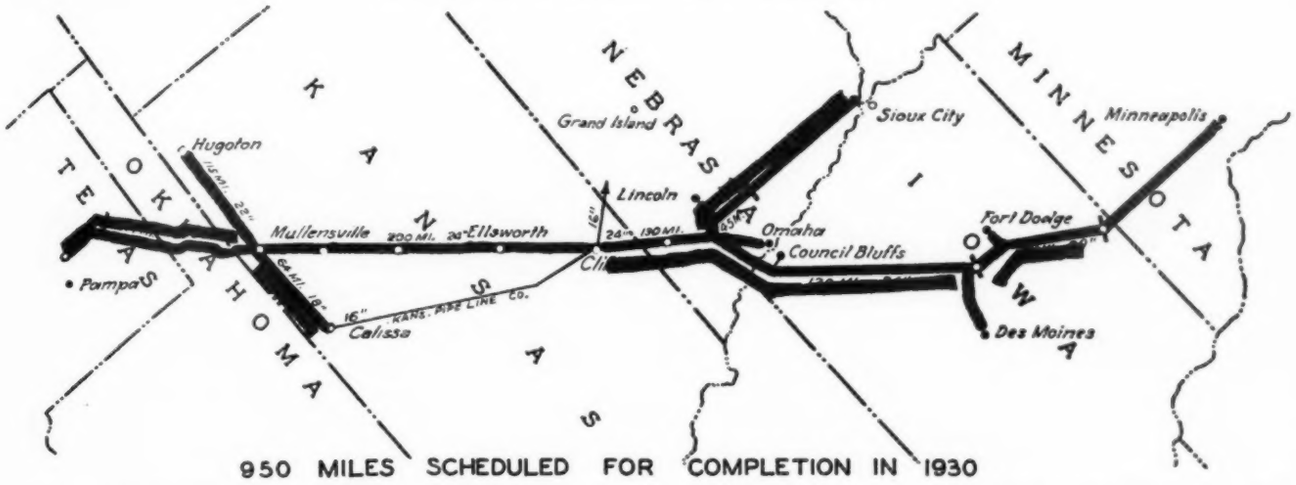
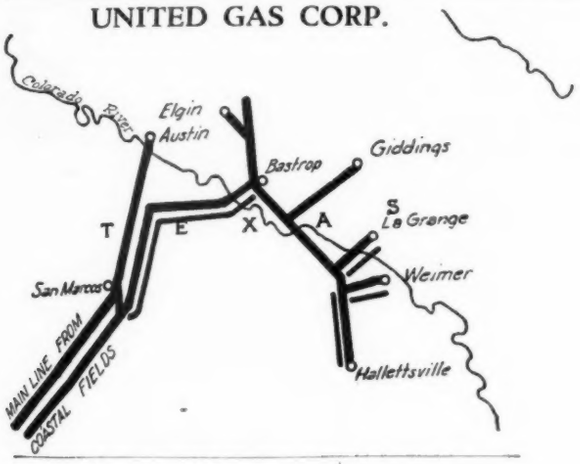
MISSOURI VALLEY PIPE LINE CO.



950 MILES SCHEDULED FOR COMPLETION IN 1930

Missouri Valley Pipe Line Co. had its 1930 construction program delayed by wintry weather to some extent, but now has less than 100 miles of line to complete. The company mapped a 950-mile construction program for 1930 and has a sizeable schedule of extension work planned for this year. The 200 miles of 24-inch between Mullinsville and Clifton in Kansas may not be started this year, and instead the company may continue to use the Kansas Pipe Line Co. system to move gas north to Clifton.

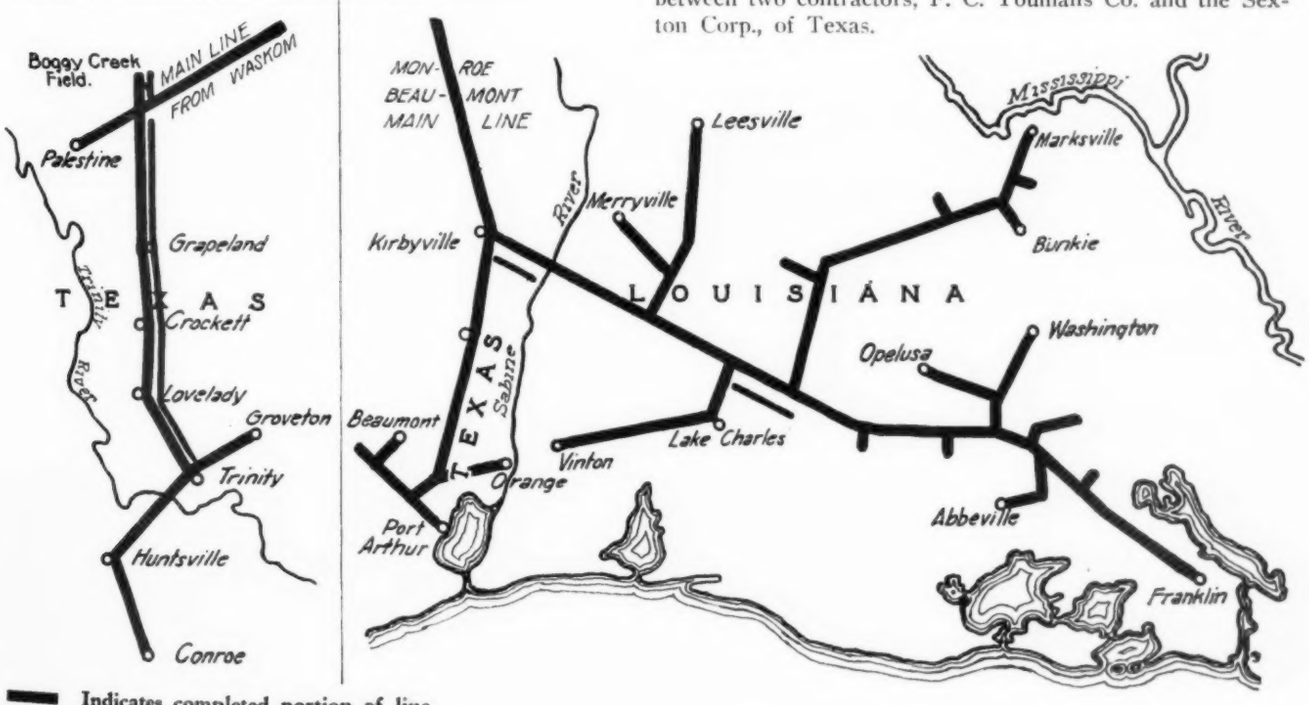
UNITED GAS CORP.



The opening of the new year finds the United Gas Corp. well along with 633-mile pipe line construction program, 400 miles of which was started this year. In addition to the main line and lateral work, the company is building three new compressor stations, a 4,000-horsepower plant at Sterlington, La., a 3,000-horsepower plant at Goodrich, Texas, and a 1,500-horsepower station at Bruni, Texas.

This work is divided in three sections, with the 100-mile Boggy Creek-Huntsville 6-inch welded line nearing completion. Over in southwest Texas the company has a 110-mile extension program well under way and which is being built with 12-inch, 10-inch and 8-inch pipe.

The major program is a 158-mile main line system with 265 miles of laterals running from Kirbyville, Texas, to cities and towns in coastal Louisiana. The line will extend as far east as Franklin, La. The construction was divided between two contractors, F. C. Youmans Co. and the Sexton Corp., of Texas.



Indicates completed portion of line.
Indicates proposed route of line.

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The Month's Activities *in* Refining*

CONSTRUCTION work on a number of new refineries, as well as several expansion programs, was announced during the past month. The White Eagle will erect in its Augusta refinery two 5,000-barrel cracking units, one 10,000-barrel vacuum rerun unit, a 5,000-barrel crude still unit, and a new steam boiler plant. The refinery capacity will be increased from 5,000 to 15,000 barrels per day.

The Kettleman Hills Gasoline Co. is building a refinery at Hanford, Calif. It will have a capacity of approximately 3,000 barrels daily.

The Vaqueros Major Oil Co. is planning a 3,500-barrel refinery in the Lompoc field. It will include a 1,000-barrel cracking unit.

The Marathon Oil Co. is planning an increase in the capacity of its Bristow refinery to approximately 10,000 barrels per day.

Several new refineries for Canada have been reported as a result of the recent duty imposed on gasoline. The Atlantic Keystone Petroleum Co. will build a 1,000-barrel refinery at Edmonton, and it is said that Sinclair Consolidated Oil Corp. will build several refineries at various Canadian cities.

The Continental Oil Co. has purchased a 1,000-barrel refinery at Albuquerque, N. M., which will be improved. This gives the Continental a total of ten refineries.

The Deep Rock Oil Corp. will install a 4,000-barrel cracking unit at its Cushing refinery.

The controlling interest in the Universal Oil Products Company was purchased by the Shell Union Oil Company and the Standard Oil Company of California for $25,000,000.

The American Institute of Chemical Engineers held its annual meeting in New Orleans for three days beginning December 8. Several interesting papers concerning the petroleum industry were presented. These included:

Applications of Hydrogenation in Oil Refining, by M. W. Boyer of the Standard Oil Co. of Louisiana.

Vapor Pressure-Temperature Relationships of Hydrocarbon Fractions, by Smith D. Turner and J. E. Pollock of the Humble Oil Refining Co.

The Long Distance Transportation of Natural Gas, by Edgar G. Hill and George I. Rhodes of Ford, Bacon and Davis.

Refinery operation figures for the past month show a slight decrease for the eastern division and a slight increase for the western division. Figures for the central division dropped from 65.7 per cent to 62.3 per cent.

Natural Gasoline

The Natural Gasoline Association of America adopted new specifications for the grading of natural gasoline on December 10. These became the sole official specifications January 1, 1931. The new grading system makes use of the Reid vapor pressure and the A. S. T. M. per cent evaporated at 140 degrees F.

The Signal Oil & Gas Co. has finished the first unit of its gasoline absorption plant at Long Beach. The capacity is about five million cubic feet per day.

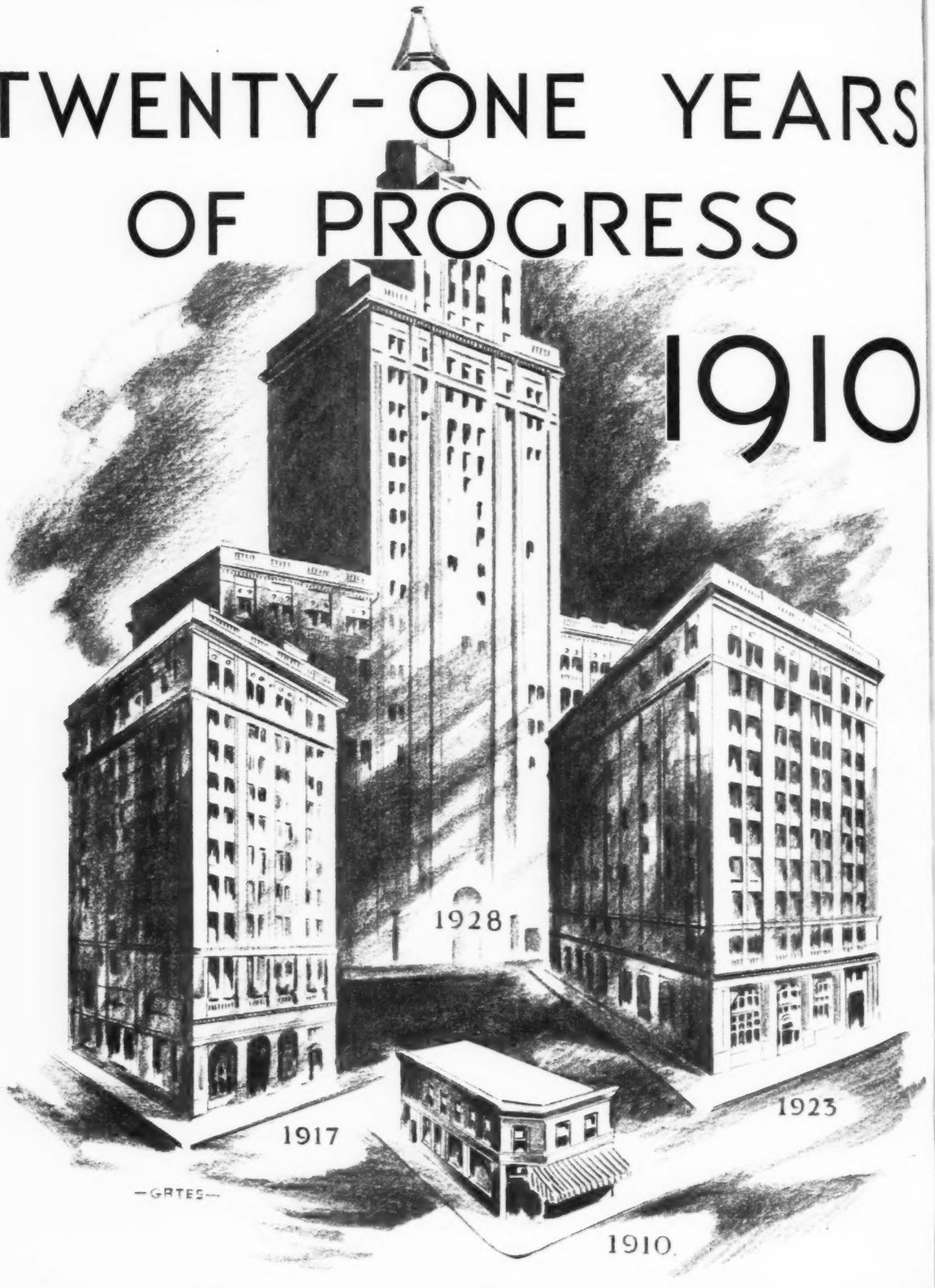
The Lone Star Gasoline Co. of Dallas has acquired the Texas and Louisiana properties of the Chestnut & Smith Corporation.

The Imperial Gas Co. will build a 3,000-gallon plant at Shiprock, N. M., to manufacture liquefied petroleum gas. The gas will be obtained from the Continental Oil Co. The Imperial will enlarge its plant for manufacturing liquefied gas at Long Beach, Calif.

Figures in red show per cent refining capacity operated.

*All statistics as of January 1st.

TWENTY-ONE YEARS
OF PROGRESS



BY THE OIL BANK

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1931

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Many New Pipe Lines Contemplated

FROM most any angle it is viewed, the year 1930 was the most phenomenal in the history of the transporting branch of the oil and gas industry. It witnessed the building of both the longest and largest pipe lines for the transmission of natural gas, with the subsequent introduction of new equipment and methods following the trend toward larger diameter pipe. It also saw the building of three long gasoline lines from refining centers to distant marketing centers and the construction of several new crude carriers. Combined, these pipe lines mounted into an investment hovering about the quarter-billion dollar mark, helped immensely in relieving the unemployment situation, were a great boon to the steel industry and afforded railroads an enormous tonnage in pipe and machinery during a dull year.

The pipe line picture of 1931 unfolds itself, indicating the new year will bring forth a construction program rivaling that of 1930.

Expansion of the natural gas industry was, of course, responsible for the greater part of the line construction in 1930, and it promises to lead the way through 1931.

In the northwest it is probable that many millions of dollars will be spent in the construction of some of the several proposed projects for that section of the nation. Proposals have been made to build a gas transmission system from Wyoming to Butte, Montana, and another plan is to build from Montana to Seattle, Washington. Several other main line systems are contemplated for this area.

It is probable that considerable expansion will be authorized for main lines in California, and plans have been rumored of the building of new lines to areas without natural gas in that state.

The great Texas Panhandle area may have another main line running north from it, providing franchises are obtained in Kansas and Nebraska cities, and companies operating in the Sunflower state already have sizeable projects patterned for 1931. Plans are being pushed for a long system running from El Paso to Douglas, Arizona, and some of the plans to build from the reserves in New Mexico may materialize.

Texas will have its share of new work in 1931, and a large part of it will come from the United Gas Corp., which has appropriated $20,000,000 for new work and expansion. About two-fifths of the appropriation will go into the expansion and improvement of existing systems, and the remainder will go to new work. Indications are that much work will be done in southwest Texas.

Several major projects brighten the prospects in the eastern territory. The line from the Texas Panhandle to Indianapolis will be completed in 1931 and may go on eastward. One of the major projects is the plan to build a 400-mile 22-inch system from Kentucky to Detroit, at a cost of approximately $25,000,000.

Another project for the east is the proposed system running from Kentucky fields to Muncie, Indiana. On farther east, plans are being shaped for new long distance lines to reach Atlantic seaboard cities and towns.

Another phase of the picture is the sizeable amount of pipe that will be used in the building of new distributing systems for towns being reached by new lines, and especially for those hundreds which have granted franchises to various companies and individuals for butane plants.

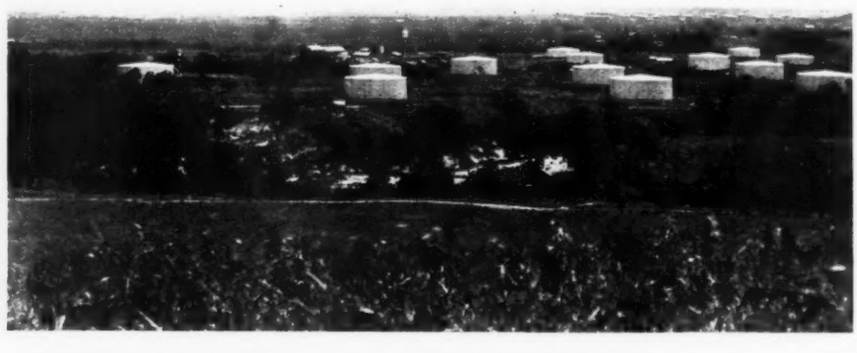
Oil and gasoline pipe lines will also be a factor in 1931. Reports have been revived that a major oil carrier will be built south from the Oklahoma City field to the Gulf Coast. A line may be built north from the Yates pool to the Mid-Continent to tie into existing systems for transportation of that crude on east to refining centers.

Plans are being considered for the construction of additional line capacity on one of the major crude lines running east from the Mid-Continent, and several short lines in the Mid-Continent as well as in other sections are in prospect. On the west coast two transporting companies are contemplating crude lines running from Kettleman Hills to coastal terminals.

It is reported that another gasoline carrier is under consideration by a major company in the east, and several laterals to the new gasoline lines will be built in 1931.

Line construction in foreign areas also has the prospect of going forward on a major scale. A large line for transporting crude is planned for construction in Roumania, and a project that is expected to require three years to build is being mapped out for the Iraq area with its large producing wells. Mexico and South America both will supply work for transporters, with the construction of a major line in Mexico and considerable work in South America. Canada, too, has a few pipe line projects being considered by various interests.

Considering all of the major projects and the numerous short lines to be built, 1931 may prove to be a close rival to 1930 from a standpoint of dollars invested in pipe, machinery and line construction equipment.



Up—up—up goes the demand for Republic Electric Weld Pipe. Gathering lines, trunk lines, construction lines,—all help swell the ever growing mileage in use credited to this most unusual pipe—more than 3000 miles placed in service.

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Consider the weld—guaranteed 100%—stronger than the parent metal—no metal added—smooth inside and out. And the pipe—perfectly round—uniform in thickness—scale and oxide removed—and long lengths in sizes 4 to 16 inch.

Plant capacity is thirty to forty miles per day and demand is taxing present capacity. Ask for a sample for test and the reasons for the popularity of Republic Electric Weld Pipe will be apparent.

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PIPE LINES UNDER CONSTRUCTION AND CONTEMPLATED FOR 1931

Type Line	Company Name	Headquarters	Initial Station	Terminal	Size Pipe	Length in Miles	Remarks
G. L.	Amtorg Trading Co.	New York, N. Y.	Moscow, Russia	Brown Coal Basin, Russia	....	150	Russian line, proposed.
G. L.	Billings Gas Co.	Billings, Mont.	Dry Creek	Billings	....	120	Est. cost $2,500,000. Bozeman western terminal. Line to go to Helena and Butte later.
G. L.	Colo. Interstate Gas Co.	Colo. Sprgs., Colo.	Devine, Colo.	Portland, Colo.	8"	28	Est. cost $500,000; welded under const.
O. L.	Continental P. L. Co.	Ponca City, Okla.	Okla. City Field	Ponca City	8"	81	Contractors, Truman-Smith, now under const.
G. L.	Central Public Service Corp.	Chicago, Ill.	Kentucky	Muncie, Ind.	18"	260	Const. work by Central Nat. Gas Corp. Proposed.
G. L.	Colorado Nat. Gas. Co.	Colorado Sprgs., Colo.	Stevens, Kans.	Colo. Sprgs.	12"	210	Proposed.
G. L.	Columbia Gas & Elec. Co.	New York, N. Y.	W. Vir.	Wash., D. C.	20"	459	Completing survey and engineering const. expected to start soon.
G. L.	Columbia Gas & Elec. Co.	New York, N. Y.	W. Vir.	Detroit	24 & 22"	300	Two river crossings in; no further work.
G. L.	Dominion G. & E. Corp.	New York, N. Y.			....	.....	Proposed to build to cities in Alberta and Sask., Canada.
G. L.	Jerome Drumheller	Spokane, Wash.	Cut Bank, Wyo.	Seattle	20"	500	Proposed est. cost $50,000,000.
O. L.	Empire P. L. Co.	Bartlesville, Okla.	Okla. City Field	Houston, Tex.	10"	475	Surveyed last year. Reported project again under consideration.
O. L.	Getty, Geo. F., Inc.	San Fran., Calif.	Kettleman Hills	Tidewater	....	100	To be completed July 31, 1931.
G. L.	Great Lakes P. L. Co.	Ponca City, Okla.	Extend to Duluth		4"	150	Under consideration.
G. L.	Gulf P. L. Co.	Pittsburgh, Penn.	Toledo, Ohio	Detroit	....	.....	Rumored.
G. L.	Public Service Co. of Nebr.		Texas Panhandle	Colo. & Nebr.	18"	.....	Making property survey. Est. cost $7,500,000.
O. L.	Mexican Eagle Oil Co.	New York, N. Y.	Vera Cruz	Mexico City	10"	142	Est. cost $4,000,000; James F. Martin, Inc., N. Y. contr.; under construction.
G. L.	Mississippi Industrial Gas Co.	Jackson, Miss.	Jackson Field	Terry, Miss., etc.	7"	140	
G. L.	Montana Power Co.	Butte, Mont.	Wyoming	Butte & Anaconda	....	.....	Est. cost $13,000,000.
G. L.	Memphis Nat. Gas Co.	Memphis, Tenn.	Extension of mains to W. Tenn.		12"	.....	Under consideration.
G. L.	Montana-Dakota Pw. Co.	Minneapolis, Minn.	Williston, N. D.	Minot, N. D.	12"	125	Making franchise surveys.
G. L.	Mo.-Kan. P. L. Co.	Chicago, Ill.	Jackson, Miss.	N. to present trunk line	....	.....	Rumored.
G. L.	Okla. Nat. Gas Corp.	Tulsa, Okla.	Big Lake, Texas	San Angelo	12"	74	Surveying, buying material; Nat. Gas Engin. Corp., contractors.
G. L.	Pacific Gas & Elec. Co.	San Francisco, Calif.	Sacramento, Calif.	Seattle, Wash.	....	500	Considering extensions to Oregon and Washington, also Kettleman Hills to Fresno.
O. L.	Sinclair P. L. Co. of Tex.	Tulsa, Okla.	Okla. City	Houston	10"	475	Rumored line will go south instead of to Chicago.
G. L.	Southern Counties Gas Co.		Goleta	Ventura	16"	33	Cost $620,000.
O. L.	Stanolind P. L. Co.	Tulsa, Okla.	Carrollton, Mo.	Wood River, Ill.	8"	240	Rumored.
G. L.	Southern Counties Gas Co.	Los Angeles, Calif.	Kettleman Hills	Los Angeles	30"	185	Under consideration.
G. L.	Tri-Cities Utilities, Ltd.	Regina, Saskatchewan, Canada	Kinsella Area, Canada	Regina, Sask.	24"(?)	357	Est. cost $25,000,000; C. O. Moore Co. project; Ford, Bacon & Davis, engineers.
G. L.	Tennessee Nat. Gas Corp.	Chattanooga, Tenn.	Sunbright, Ky.	Chattanooga	....	160	Est. cost $2,000,000; contract to Gas Power Corp., 75 Broad St., New York.
O. L.	United Producers P. L. Co.	Ft. Worth, Tex.	Yates, Tex.	Glenn Pool, Okla.	10"	.....	Rumored.
G. L.	Western Natural Gas Co.	El Paso, Tex.	El Paso, Tex.	Phoenix, Ariz., & Roswell, N. Mex.	12"	300	Control by El Paso Nat. Gas. Co.

Checking Engine and Compression Performance by

The Use *of* Indicator Diagrams

By H. V. BECK,
Assistant Professor of Mechanical Engineering, University of Oklahoma

THE use of indicator diagrams as a means of checking engine performance is not new to most men connected with gas compressor stations, but their full significance as an indication of the condition of the compressor is not commonly understood. In this article the author attempts to show by the use of indicator diagrams, the condition of the compressor and the correct time of ignition together with a horsepower and mechanical efficiency determination for a typical engine driven compressor.

The indicator diagram is a graphical representatjon of the pressure conditions within a closed cylinder, the vertical co-ordinate being proportional to the pressure while the horizontal co-ordinate is proportional to the piston displacement. The analysis of an indicator diagram becomes a simple process if one keeps this in mind; as an example, a typical compressor diagram, Fig. 1, will be analyzed.

At the beginning of the compression stroke A, the gas within the cylinder is at intake pressure. As the piston starts reducing the volume of this gas, the pressure accordingly rises along the line A-B. At B, a point slightly in excess of the discharge pressure, the existing pressure differential causes the discharge valve to open and further movement of the piston results in discharging gas at this pressure along the line B-C. In all compressors there is a certain amount of clearance space which at C is filled with gas at the pressure of discharge. This gas must expand down along the line C-D until at D, a point sufficiently below the intake pressure to open the intake valve is reached. During the remainder of the return stroke, from D to A, gas flows into the cylinder, filling it at the pressure of intake. The ratios of the length D-A to the total length of the diagram is commonly referred to as the volumetric efficiency since it is the portion of the intake stroke during which gas is drawn into the cylinder. In the following discussion the different portions of the diagram will be referred to as follows: AB—Compression line, BC—Discharge line, CD—Re-expansion line, and DA—the intake line.

Figure 2 is a diagram in which there is evidence of a leaking intake valve. The high pressure gas in the clearing space partially leaks back through the faulty intake valve, causing the re-expansion line to drop more quickly, showing an apparent, though erroneous, increased volumetric efficiency. The intake line may be wavy or sagging below a line corresponding to the intake pressure. The compression line will fall below the normal compression line since the gas will start leaking back through the bad intake valve as soon as the pressure begins to rise.

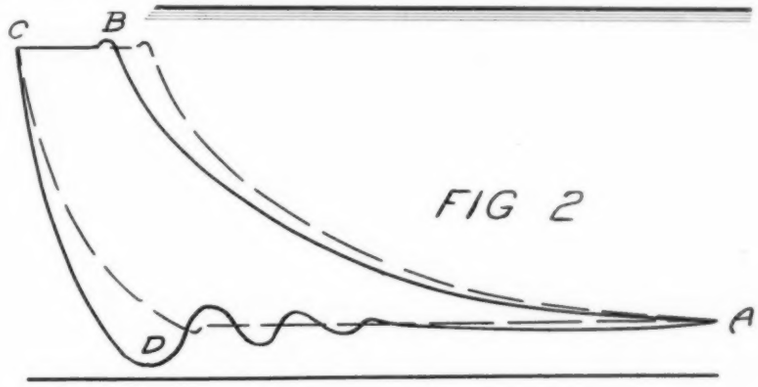


FIG 2

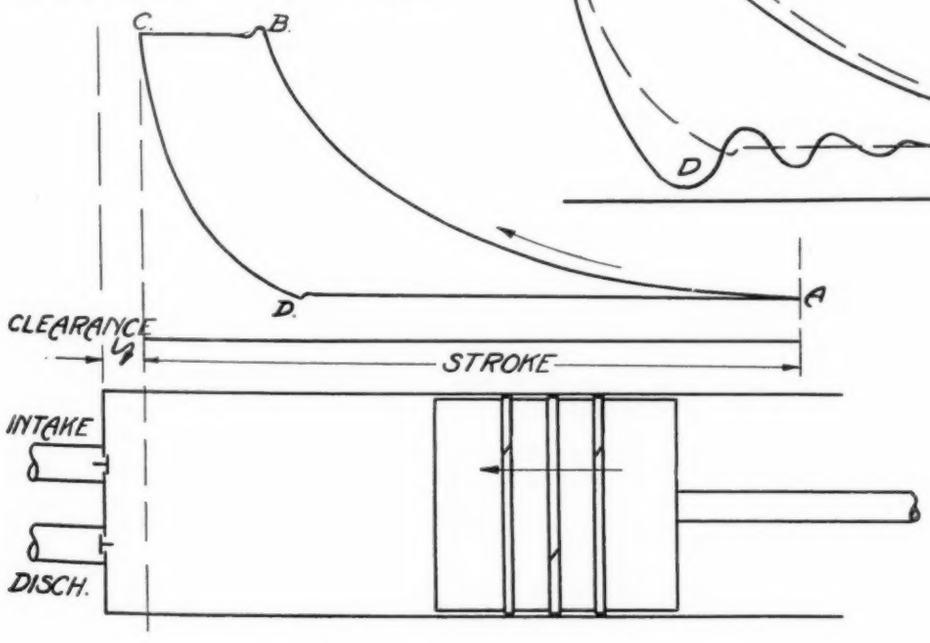


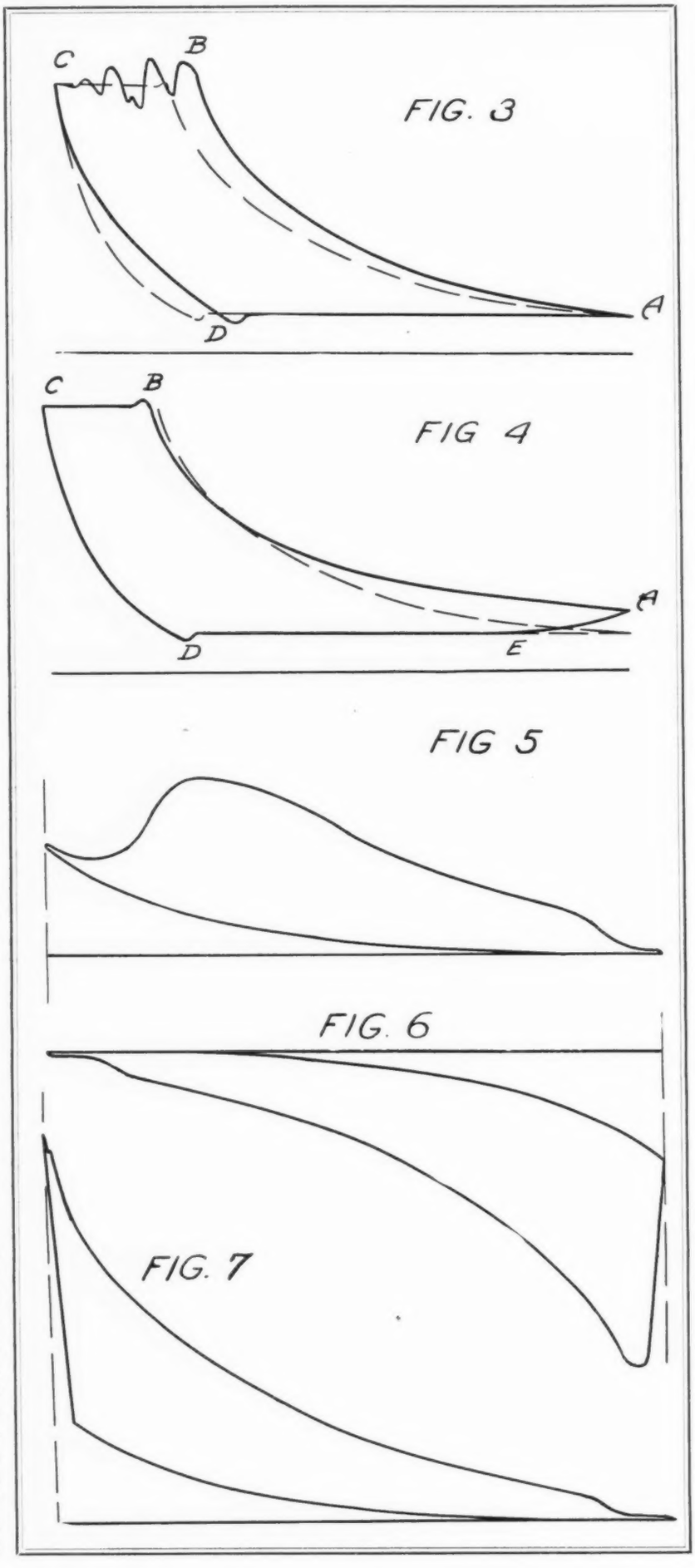
FIG. 1.

If a discharge valve is leaking and allowing high pressure gas to flow back into the cylinder, as in Figure 3, the compression line will be above that of the normal diagram since for any piston position the pressure will be greater than it would ordinarily be. The discharge line will be wavy and often above the line corresponding to the discharge pressure due to broken or clogged valves. The re-expansion line will swing farther from the vertical since the high pressure gas leaking back

through the discharge valve will supplement that in the clearance space, causing a higher pressure to exist for any piston position during the period of re-expansion. A bad discharge valve will in this manner, reduce the volumetric efficiency considerably. The quantity of gas pumped will be reduced even more, since dilution of the intake gas from the leaking valve is occurring during the decreased length of intake.

It is not always necessary to take an indicator diagram of a compressor to find a faulty valve. If the valve is in very bad condition it will evidence itself in excessive heating. Leakage past the piston rings is not as readily detected, however. The only evidence of this trouble, except from the diagram, is the decreased output, and if several compressors are on the line it is a difficult proposition to tell which one is at fault.

The indicator diagram of a compressor where leakage is occurring past the rings, shows a "toeing up" of the intake line (Figure 4). This "toeing up" of the intake line is due to the decreased piston speed near the end of the stroke, allowing the gas to leak past the rings at a faster rate than the volume is increasing, and also because at this portion of the stroke the gas on the other side of the piston is at its maximum pressure. The actual volumetric efficiency is somewhat less than that denoted by the length D-E, since it is quite evident that gas cannot enter the cylinder from E to A where the cylinder pressure exceeds that of the intake.



An engine card with ignition at the proper time is shown in Figure 5. A card of this shape may be obtained with the spark occurring about five degrees before dead center, the exact amount depending upon the engine speed. Setting the magneto so that at half-retard it will break on dead center is a good rule for approximate adjustment.

Figure 6 shows the diagram characteristic of late ignition. Although late ignition is not desirable for normal operation, its characteristic, more uniform torque output makes it desirable for slow speeds when there is a possibility for the engine stalling.

Ignition which occurs too early in the cycle will result in a card as shown in Figure 7. The extreme explosion pressures thereby obtained may result in knocking and perhaps failure of the pins and other bearing surfaces, due to the high stressing resulting from such a condition.

Where the engine speed is governed by throttling of the fuel gas, lean mixtures may result from light loads which produce cards

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that are in general appearance similar to a late spark. It is necessary for this reason to have a full load on the engine when observing the ignition. Heavy loads are often accompanied by a rich mixture which evidences itself in a wavy expansion line caused by after-burning of the fuel.

The indicated horsepower of an engine or compressor cylinder is determined by use of the formula:

$$H.P. = \frac{PLAN}{33{,}000}$$

where,

P = Mean effective pressure in pounds per square inch.

L = Length of stroke in feet.

A = Cross sectional area of cylinder in square inches, deducting the area of the piston rod on the crank end.

N = Revolutions per minute or one-half of the R.P.M. in the case of a 4-cycle engine.

The only one of the above factors that is likely to cause any difficulty is the mean effective pressure. This valve is the product of the area of the card and the spring scale divided by the length of the card.

In order to simplify the method of procedure, the author includes sample calculations for a typical horsepower and mechanical efficiency determination. The unit upon which these calculations were made was a 16-inch by 9-inch by 20-inch twin, high stage compressor unit, driven by 2-cycle gas engines.

This article is based upon a series of indicator tests made during the past few months in several of the I. T. I. O. Company compressor stations in the Oklahoma City field. The author welcomes any criticisms, suggestions, or queries in regard to any statements made herein.

Horsepower Table

	Right-hand Side	Left-hand Side	Total
Power Cylinder	118.0	122.2	.....
Scavenging Cylinder	—10.9	—11.8	.....
Power Output	107.1	110.4	217.5
Crank End Compressor	39.1	42.5	.....
Head End Compressor	44.6	40.8	.....
Power Absorbed by Compressors	.....	.....	167.0
Friction Horsepower	.....	.....	50.5

$$\text{Mechanical Efficiency} = \frac{167.0}{217.5} \times 100 = 76.8\%$$

Sample Horsepower Calculations

1. Area of diagram for the right-hand compressor, crank end: 1.78 square inches.

2. Length of diagram: 3.65 inches.

3. Mean effective pressure, using a spring scale of 150 pounds:

$$\frac{1.78}{3.65} \times 150 = 72.3 \text{ pounds per square inch.}$$

4. Length of stroke: 20 inches or 1.67 feet.

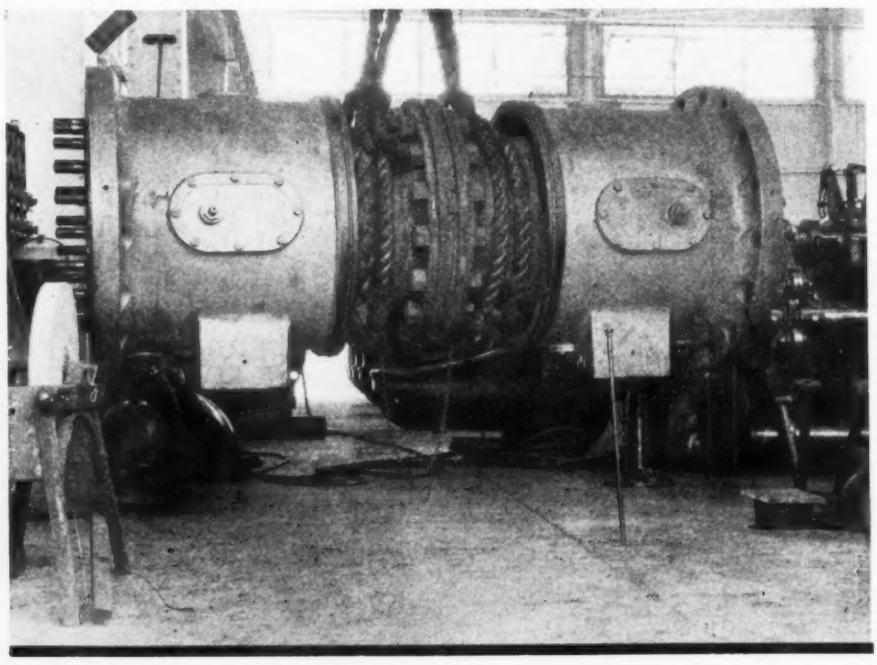
5. Cross-sectional piston area, 9-inch diameter piston, 2.5-inch diameter piston rod:

$$\frac{3.1416}{4}(9.0^2 - 2.5^2) = 58.7 \text{ square inches.}$$

6. Engine speed: 180 r. p. m.

7. Indicated horsepower:

$$\frac{\text{Plan}}{33{,}000} = \frac{73.2 \times 1.67 \times 58.7 \times 180}{33{,}000} = 39.1 \text{ h. p.}$$



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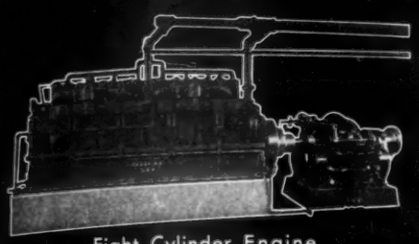
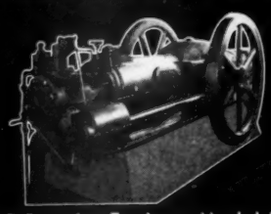
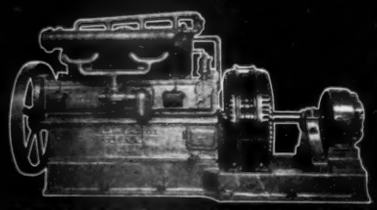


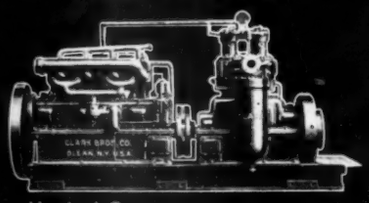
Eight Cylinder Engine
with Froude Dynamometer attached.



40 H.P. Pumping Engine—Model PB40



Gas Engine Generator Unit—Model ES4G—75 K. V. A.



Vertical Compressor—Model VP

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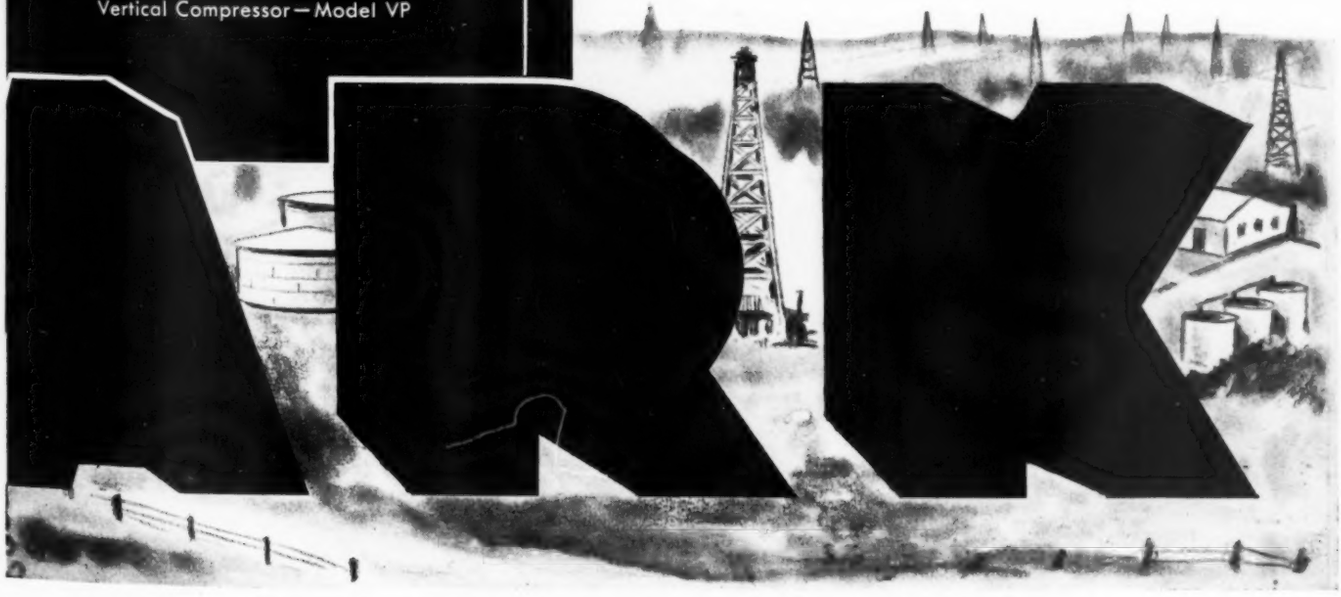

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The Crystallization of Petroleum Wax

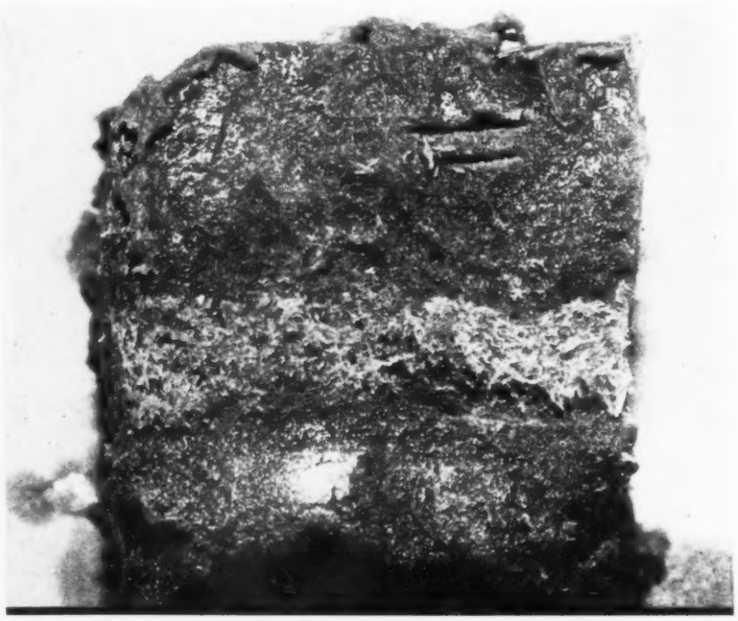
By FRED W. PADGETT
Prof. Petroleum Engineering, University of Oklahoma

THIS article on wax crystallization should be of great interest to refiners of paraffin base oils. The author is an outstanding authority on the subject, having spent many years in research work along these lines. Professor Padgett is head of the department of petroleum refining at the University of Oklahoma. This institution has the most complete refining equipment to be found at any university.

IN RECENT years the petroleum waxes have been the subject of considerable study. The reason for this activity has been not so much the value of the wax itself as the necessity of its removal from lubricating oil stocks and the problems arising in connection with this operation. Also, a paper given in 1926 by the writer and co-workers at the Tulsa meeting of the A. C. S., served to stimulate interest in the subject and subsequent research.

In 1888 Zalozieki, working with petroleum wax and ozokerite, concluded that these substances contained both crystalline and amorphous waxes. He advanced the theory that the amorphous wax was composed of branched chain hydrocarbons and the crystalline wax composed of normal or straight chain hydrocarbons. Marcusson also adhered to this theory and claimed to produce an amorphous wax by heating montan wax with Kieselguhr. The chemists of the Grosny Research Institute in Russia, at the present time believe in the existence of a type of wax, differing from the ordinary paraffin wax, and which for want of a better name they designate as ceresine wax.

A description of the important natural waxes may be desirable in this connection. Montan wax occurs associated with certain pyrobitumens and can be extracted by a solvent. It contains hydrocarbons, acids and esters, the total percentage of the last two often being considerable. Ozokerite differs from montan wax in that the acids and esters are almost wholly lacking. The refined ozokerite is called ceresine and contains mainly saturated hydrocarbons. Ozokerite might result from an evaporation process imposed upon paraffin base oil in nature, then again there is the possibility that it might be formed from the decomposition of a substance resembling montan wax. Considerable space might be devoted to speculation concerning the origin of montan wax and ozokerite, but is not justified here.



A cake of slack wax.

Also Zalozieki called his amorphous wax protoparaffin and the crystalline wax pyroparaffin, the supposition being that the latter might be formed from the former by a process of pyrolysis.

The work of a number of investigators comes up more or less in opposition to the protoparaffin theory of Zalozieki, especially that of Gurwitsch, who stresses the effect of associated substances on the crystal size. He distilled a sample of so-called amorphous wax (petrolatum) under conditions wherein pyrolysis was minimized and secured a distillate having wax crystals much larger than the original or the residue. Mixing distillate and residue together gave a product with crystals approximately the same size as the original. This experiment demonstrated at least that crystalline wax could be produced without cracking and indicated that the effect of associated substances had an important bearing on the crystallization. The line of attack in many investigations have been attempts to separate the waxes in a state free from impurities. Among these workers may be mentioned Mabery, Kraft, Francis Watkins and Wallington. Piper, Brown and Diment, apply x-ray analysis to the hydrocarbons secured by Francis, Watkins and Wallington from shale oil and conclude they are the normal hydrocarbons. Reistle and Blade report the probability of several different series being present in the waxes separated from Panhandle crude by solvents.

The crystal system and habit of the petroleum waxes also has received attention. Wahl finds considerable variation in the crystal systems of the lower paraffins, also polymorphism. McLennan & Rummer, applying the Debye powder method of x-ray analysis to nor-

mal pentane, hexane and octane, reports that those hydrocarbons crystallize in the orthorhombic and monoclinie systems. Muller and Saville discover through x-ray analysis that n-eiocosane and n-octodecane give at least two crystals modifications. According to Pyhäla, plate and needle crystals are related to one another in the rate of cooling, while Carpenter claims a transition point between plate and needle crystals at a temperature 5 to 10 degrees below the melting point. Hefley, using the petrographic microscope, was unable to detect any polymorphic change on cooling a sample of wax. The waxes, according to Hefley, are invariably orthorhombic. This conclusion is verified by Rhodes and co-workers and by Tanaka and others. Hefley also reaches the conclusion that the sweating and pressing characteristics can be judged accurately by microscopic examination and stresses the importance of impurities on the crystal habit. Rhodes and co-workers find that the needles are formed by curling of the plates. Tanaka reports that the plates grow by parallel addition to the fundamental romb and the needles by successive growth parallel to the 70-degree angle. One of the peculiarities of needle growth observed by the writer has been a species of skeleton growth; first the formation of a fine needle, then lateral filaments, finally the figure filling in to produce a large needle. Buchler and Graves conclude that needle growth is due to the presence in small quantity of an impurity they designate as "soft wax" which in larger percentages acts to inhibit crystallization. They do not identify the soft wax impurity. Gascard observes in connection with the synthesis of higher paraffin hydrocarbons that when the waxes are pure they tend to give plate crystals, when impure, needle crystals.

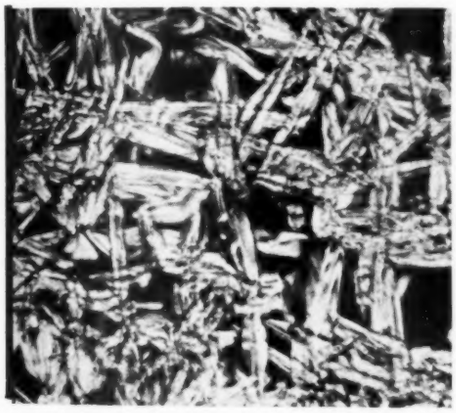
Myers and Stegeman report that waxes form solid solutions with one another and that wax apparently retains oil as a solid solution of oil in wax.

O'Neill finds that Fuller's earth is more effective in the removal of crystallization hindering impurities than several precipitations with a solvent. The crystal habit is the result of the combined effect of such factors as rate of cooling, viscosity of medium, and impurities present. O'Neill also decided that incomplete or limited isomorphism existed in some of the samples studied by him.

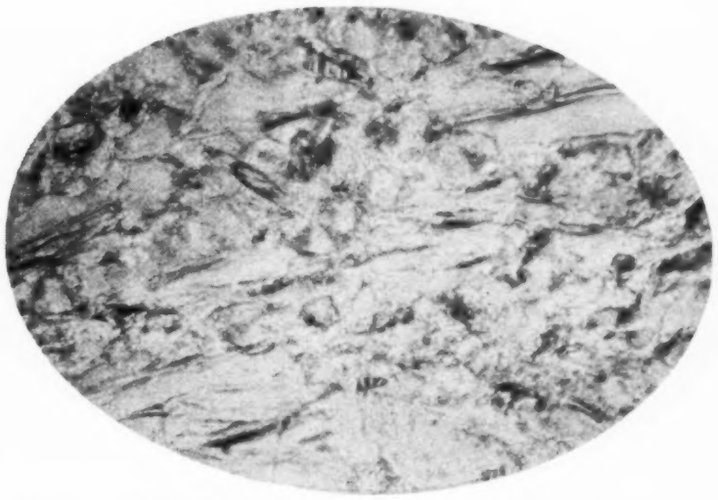
Peck employed the dilatometer in the study of wax-containing products. A very poor sweating product produced four breaks on the temperature-volume curve and is explained as being due to oil of crystallization.

Gage studied the effect of impurities on the crystallization. The effect is quite complicated though positive. He found that the effect of very finely divided or colloidal substances was mainly to affect the size of the crystals. Another class of impurities reduced the number of crystal nuclei, sometimes also affecting the crystal size. Still another class apparently suppressed the formation of needle crystals. He also observed the phenomenon of recrystallization and its dependence upon the time element.

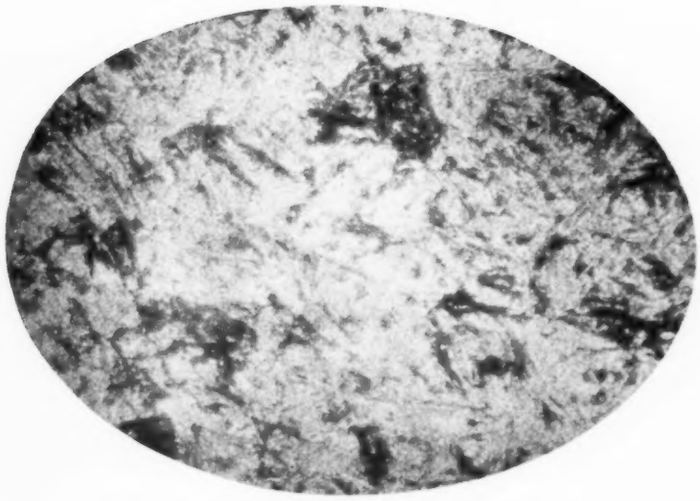
Jones and Blachly attribute the differences between amorphous and crystalline wax as being the result of variation



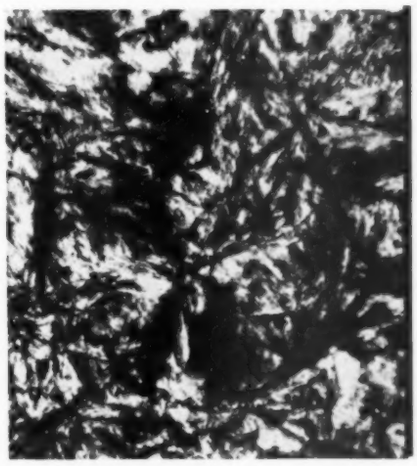
Needles in good sweating slack wax.



Thin section cut from block of paraffin wax of commerce.



Thin section cut from wax separated from petrolatum.



Poor sweating slack wax. (Magnifications of all pictures about 100, using polarized light.)

of surface tension induced by the presence of impurities.

Ferris and co-workers report the conclusion that petroleum wax contains a number of types of hydrocarbons besides the normal compounds and suggest that these are the branched chain hydrocarbons rather than unsaturated or cyclic compounds.

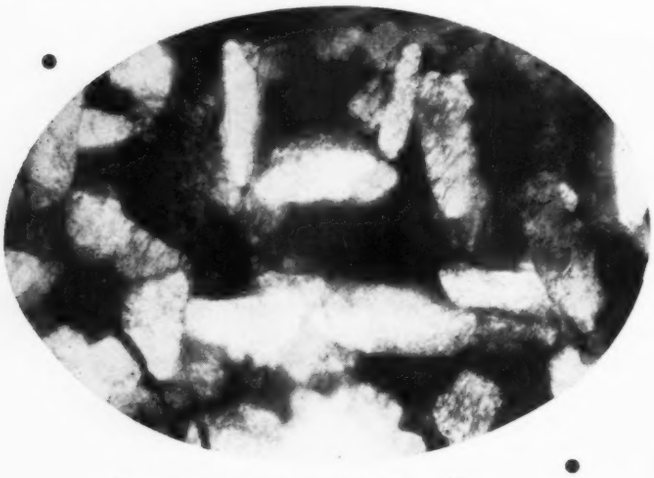


Plate crystals in good pressing wax distillate.

The references given below do not include all the work done, but perhaps the most important papers dealing with the nature and crystallization of petroleum waxes. It seems to the writer that the following conclusions can be drawn from the work of various investigators.

(1) The microscope can be depended upon to give valuable information concerning the suitability of products for industrial operations, particularly sweating and pressing.

(2) The crystallization is materially affected by cooling rate, viscosity of medium but especially the presence of impurities which modify or inhibit crystallization. Perhaps these impurities are branched chain hydrocarbons. Perhaps they may be compounds of a highly dispersed nature such as asphaltic matter, or hydrocarbons in other series. The impurities are adsorbed or occluded in the crystallizing wax thus affecting the crystal habit.

(3) The rate of cooling has more effect on crystal size in the lower than in the higher distillates and residues.

(4) The wax crystals are in the orthorhombic system.

(5) Slight branching of the chains would not necessarily throw the hydrocarbons out of the orthorhombic system, but marked branching should produce hydrocarbons in other systems. This marked branching may cause the hydrocarbons to become soft or amorphous and the surface tension overcome the tendency to form crystals.

(6) It is probable that the waxes in the lower lubricating oil distillates mainly are the normal or straight chain hydrocarbons.

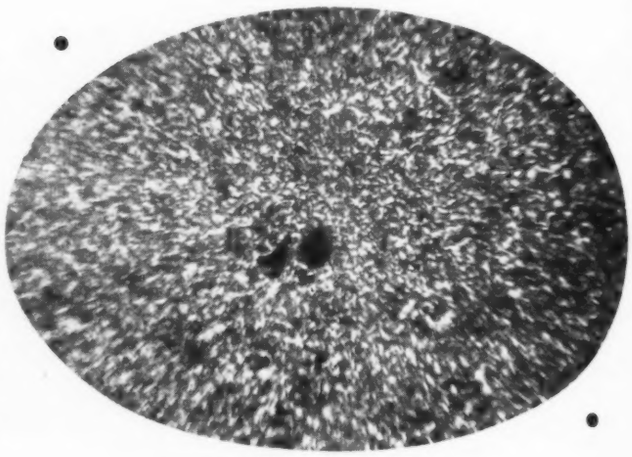
(7) While actual oil of crystallization, analogous to water of crystallization, does not appear tenable, the mode of crystallization is of such nature at times that oil readily could be inclosed in the wax. The work of Myers and Stegeman is not at variance with this conclusion.

(8) The crystal habit of the waxes is as follows: plates, needles, and a fibrous, feathery form. The plates are the most stable form and needles will recrystallize to form plates.

(9) Finely divided and colloidal substances have a definite effect on the crystallization.

(10) While the importance of associated substances is recognized in the crystallization, there also is the suggestion that the higher the molecular weight of the wax, the less definite is the tendency toward forming good crystals, due to the nature of the wax or possibly isomorphism with associated substances.

(11) Reverting to Zalozieki's theory, it is not at all impossible to have in "amorphous" wax, soft wax crystals and heavy oils, also a smaller proportion of hard wax finely dispersed. However, it is not necessary to assume that



Petrolatum.

crystalline wax is produced by cracking the amorphous wax. While the older method of preparing lubricating oil distillates for pressing consisted in combined cracking and fractionation, the method now used is carefully controlled fractionation.

(12) Dilution favors plate crystals; rapid cooling favors small crystals and needles; high viscosity of medium favors smaller crystals and needles; impurities favor needles, fibres, and "amorphous" wax.

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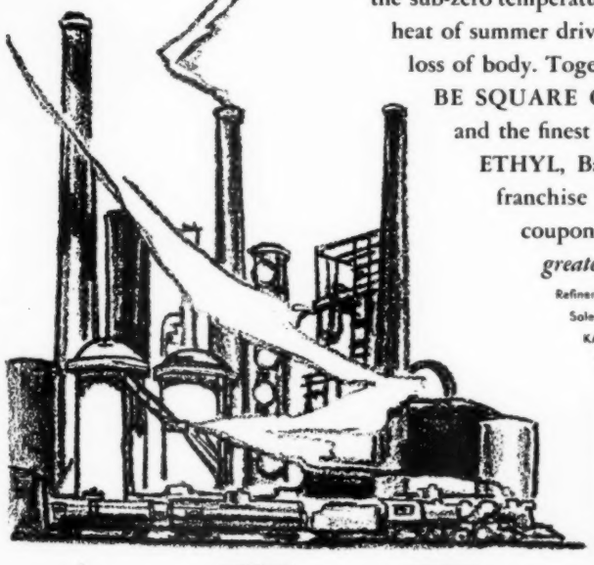

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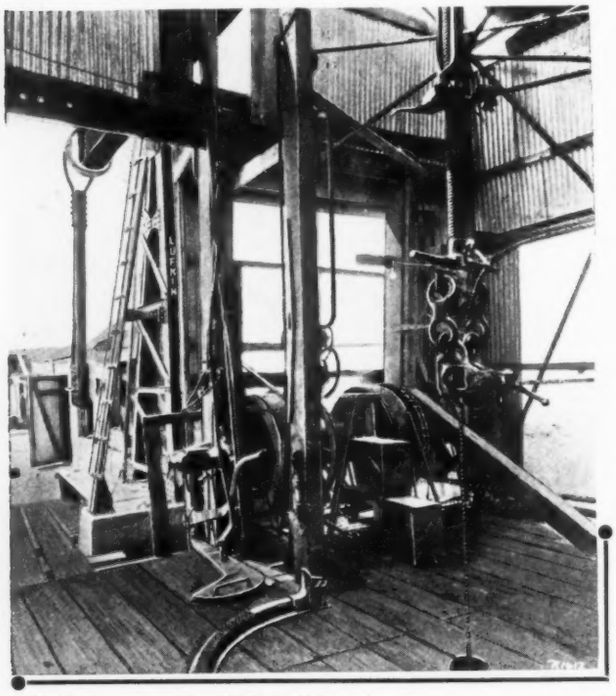
A NEW departure in cable tool drilling that has attracted considerable attention is the recent drilling of an oil well on which a pumping unit, set up in regulation fashion, was used as drilling machinery.

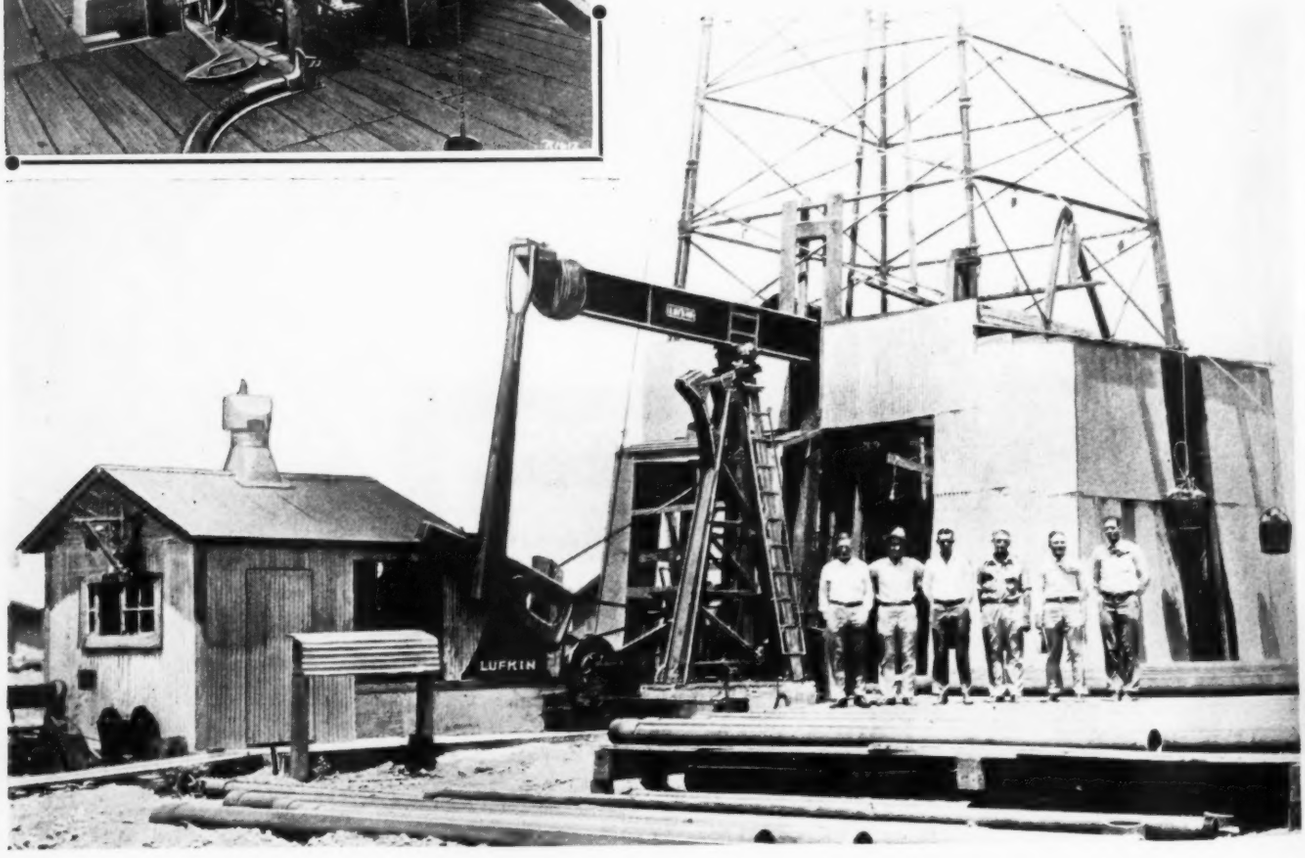
A very careful check on the test has given the operators much information, a large portion of which is very valuable. The data include a complete survey of the energy consumption, drilling time by days, casing setting, etc. The results, as a whole, are perhaps more satisfactory than expected at the time the installation was rigged up.

A feature of the set-up was the fact that after the completion of the well it was not necessary to tear out the drilling equipment in order to install pumping machinery, since the same equipment was left in place for the pumping of the well. It was with this idea in mind that the Simms Oil Company decided to use the pumping equipment as the drilling power. The installation was made on the company's University "A" lease, well No. 3, which the Simms Company jointly owns with the Phillips Petroleum Company. The location of the well is at Penwell, Texas.

The installation is really quite simple. It consists of a 25/55-horsepower, 440-volt, 1200 r. p. m. electric oil-field type motor connected by means of a "V" type belt to



At left—The rig floor and equipment. Below—Close-up of the rig and drilling crew (from left to right): T. J. Saugher, tool dresser; E. D. Ruse, driller; E. T. Barnes, tool dresser; A. T. Nuttal, driller; J. D. Best, representative for Lufkin Foundry and Machine Company, makers of the unit; and S. P. Todd, tool pusher.



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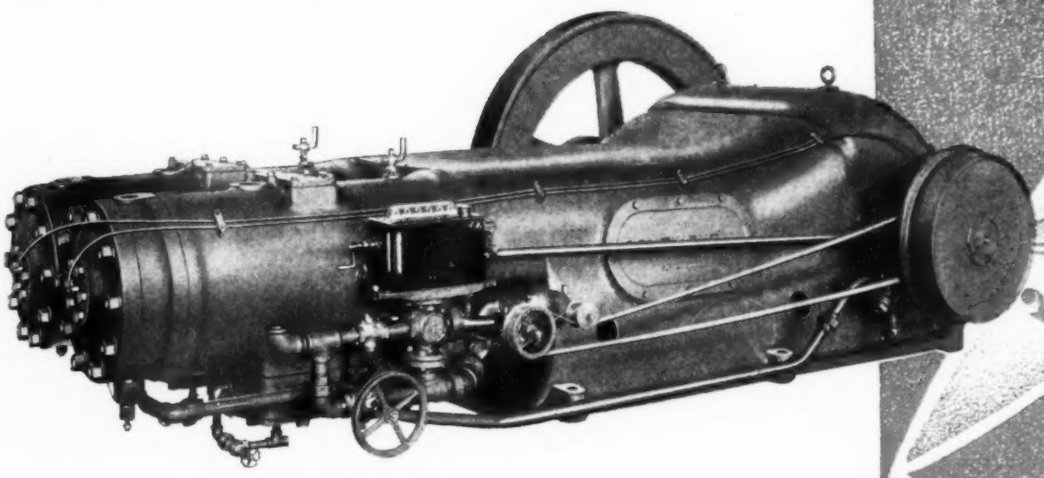

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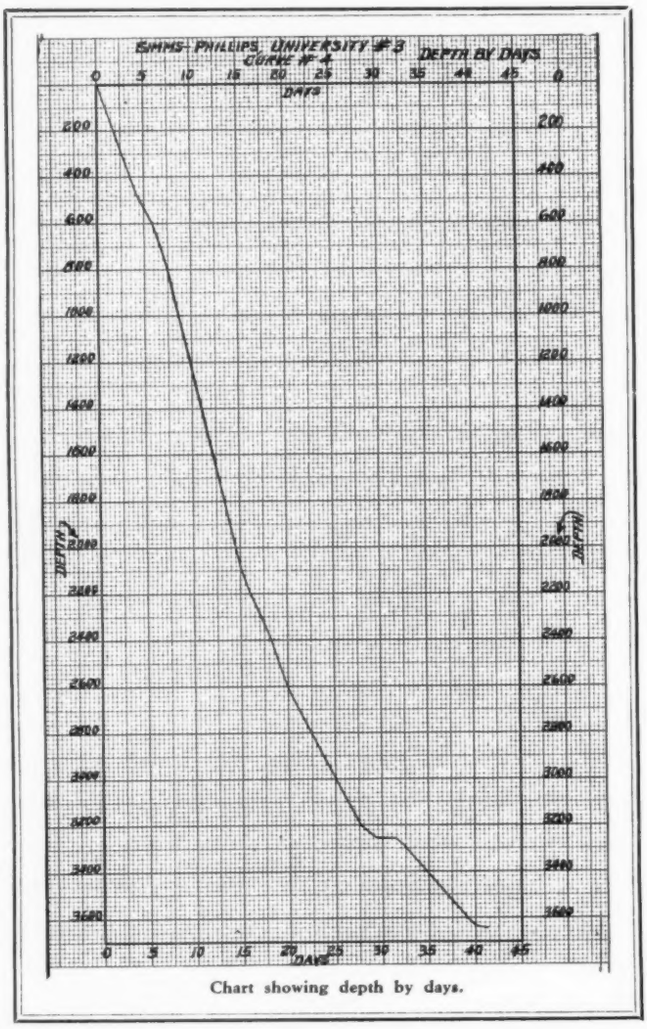

Chart showing depth by days.

the gear pumping unit. The electric motor driving the pumping unit served as the sole drilling power on the well and will also be used as the pumping power.

This unusual set-up delivered very favorable results in many ways, as can be seen from a review of the drilling time and casing setting record. A total depth of 3649 feet of hole was drilled in 41 days. This included the setting of all casing, etc. The well was spudded in at 2:00 a. m., June 24, 1930, and was completed at 12:00 noon on August 3, 1930. A chart included in this story shows a drilling log of the well and gives each day's progress as the well was being drilled. Another chart shows the total depth and power consumption. This chart shows that slightly less than 34,000 K. W. H. electric current was used in drilling the well, and that the rate of current used remained constant throughout the operation. Some very remarkable time was achieved in setting the casing in the hole. The surface pipe, which consisted of 655 feet, or 33 joints of 10-inch pipe, was set in two hours' time. The next casing point was at 2,243 feet, where 78 joints of 32-pound, 8¼-inch pipe was set in two hours and fifty-two minutes. The last casing point was at 3,250 feet. Here 150 joints of 24-pound, 6⅝-inch casing was set in five hours and three minutes. This constitutes a very fast speed in setting casing and demonstrates the ability of both the equipment and crew.

It is claimed by the manufacturers of the equipment used on the rig that the drilling of this well was made in record time for cable tool operations in this district. That it is a remarkable achievement is shown by the fact that the hole was drilled at an average rate of 89 feet per day, including time required to set three casing strings. Considering the setting of the casing, and waiting on the cement to set, the actual average drilling speed per day was considerably faster, and on many days exceeded well over 100 feet.

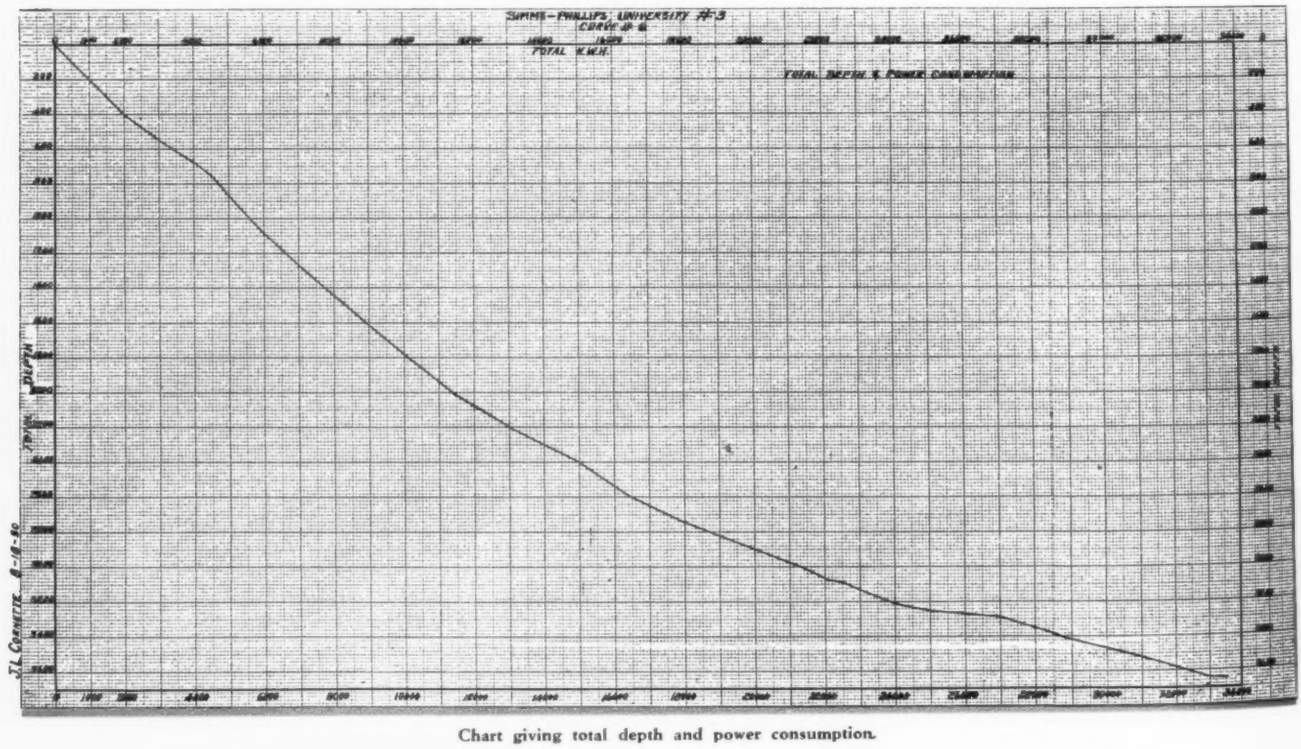

Chart giving total depth and power consumption.

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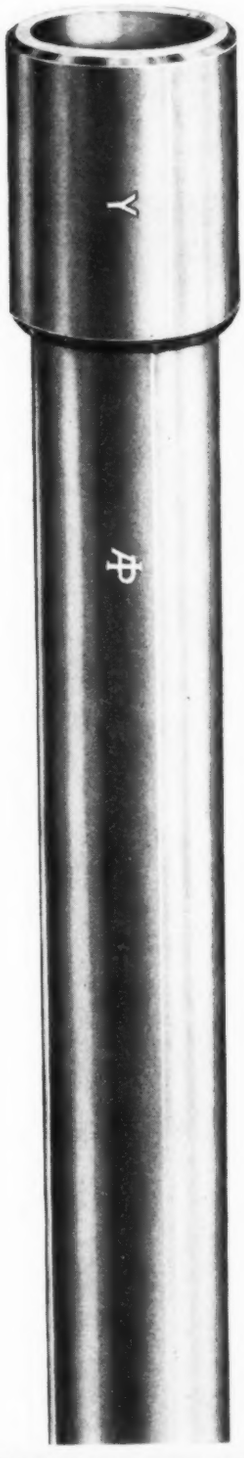

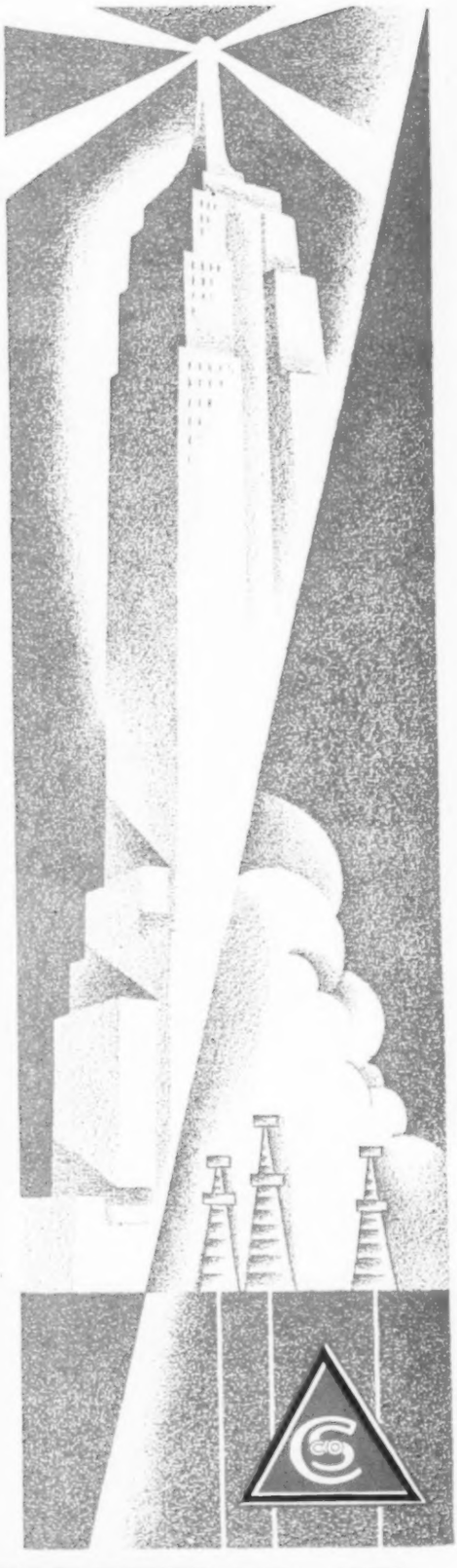

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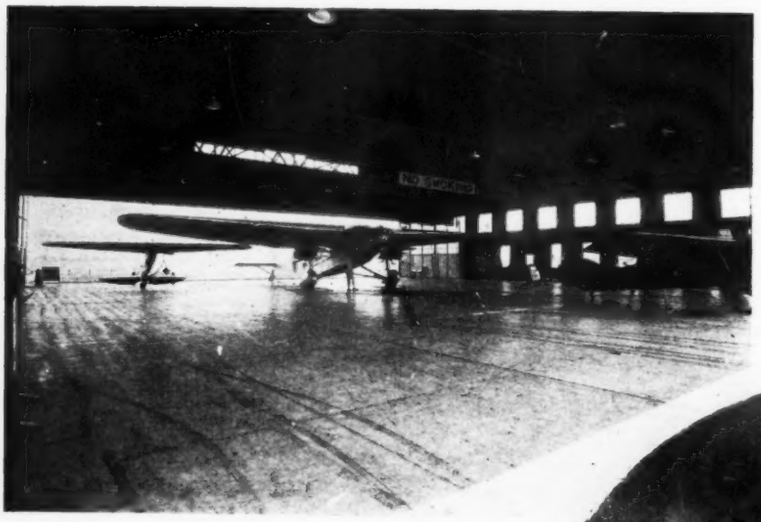
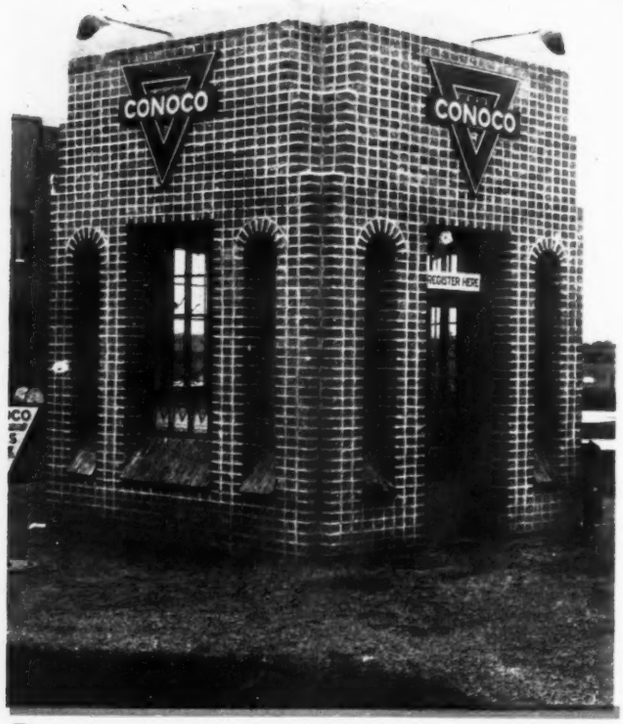


Inside view of the hangar.

Electrical control equipment housed in the southeast tower room.

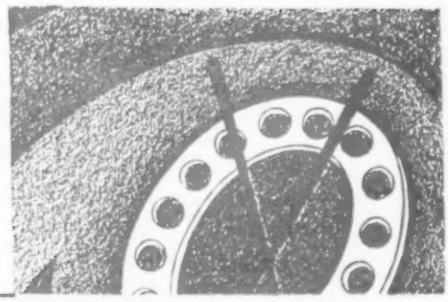


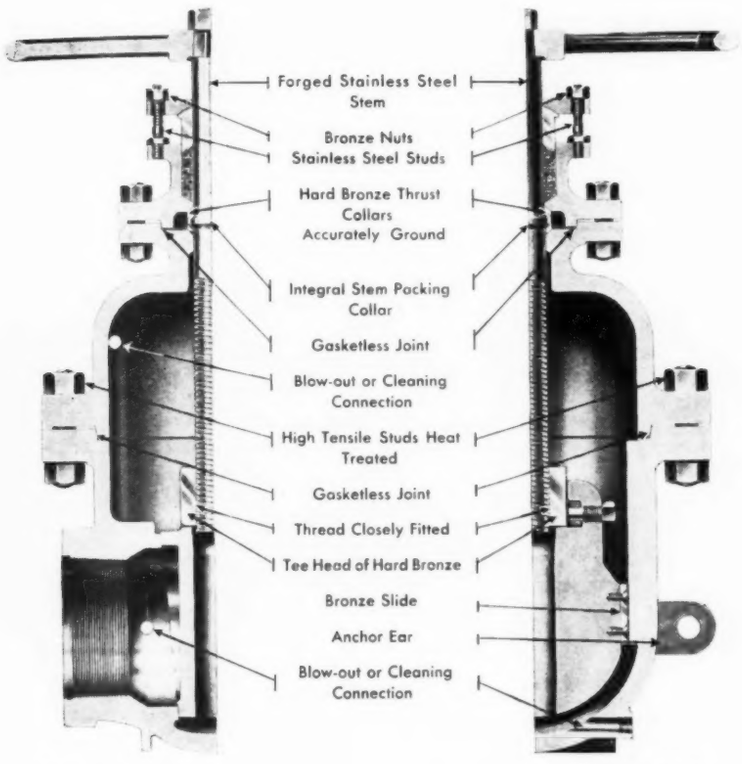
The service station, which is a miniature duplicate of the tower room and houses gasoline, air and water service pumps and motors.

IN conjunction with the policy of the Continental Oil Company further to adopt air travel as a means of bringing its holdings and markets within quicker traveling time from its headquarters at Ponca City, Okla., the company has constructed a model, modern, fully equipped airport that is open to the public for general use. The company also has recently increased its fleet of airplanes, now having nine that are used for company business trips. This number probably exceeds that of any fleet in use by a corporation actually outside of the airplane industry. The fleet has gradually been increased to its present size with the growing use of air travel by its officials, and nearly any day some of these planes can be found far from home.

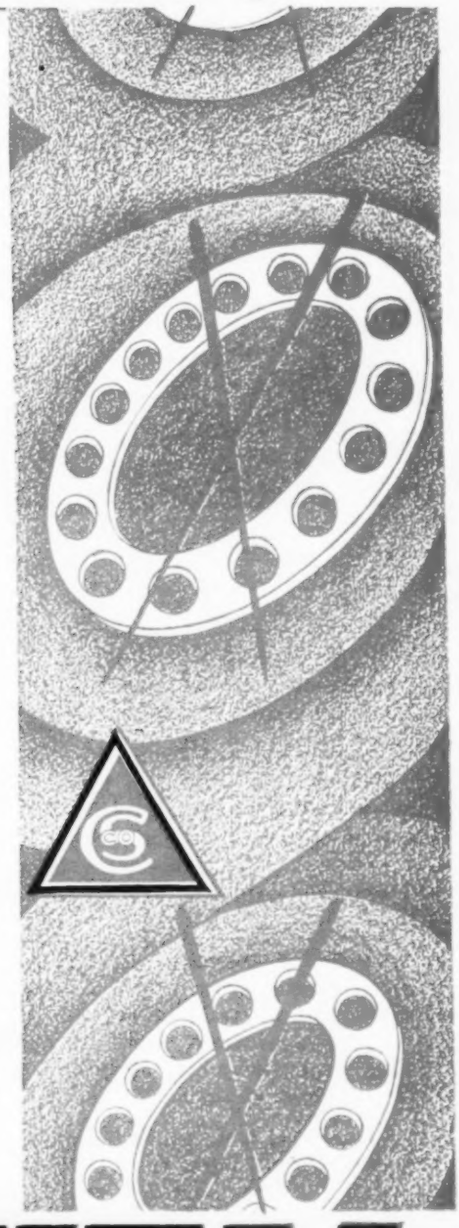
The new Municipal Airport at Ponca City is fast gaining the reputation of being one of the nation's best. The port was designed to be as accessible and safe as possible and available for both day and night flying with the wind in any direction. The landing area is laid out in four runways, providing landing space for the wind in eight different direc-

THE NEW WESTCOTT DRILLING GATE VALVE HAS NO GASKETS





Cross Vertical Section — Longitudinal Section



Leaks, blow-outs, replacements and the inconvenience caused by valve gaskets can't happen in this new Westcott Valve. Tapered, ground joints give leakless, trouble-free service and eliminate the gaskets. The full, free floating (until seated) solid wedge with bronze slides, operates with a minimum of friction along a machined steel guide in the body.

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tions. Each runway is 500 feet wide and the shortest is 2,640 feet, with the longest 3,300 feet. The runways are heavily sodded and are extremely smooth; an automobile can be driven up to 70 miles per hour on any one of them, whereas a landing area capable of allowing a car to travel 20 miles per hour is considered satisfactory for airplane landing.

A perfect natural drainage is obtained, owing to the topography of the field. There is a slope from the center in all directions with a maximum grade of one and one-half per cent. The runways are all bordered with concrete blocks set flush with the ground. These blocks are 18 inches square and are painted white for visibility and are bordered by an oil strip five feet wide to prevent the encroachment of grass.

View of the field from the air, taken the day the airport was dedicated.

A bank of landing floodlights. The field has three similar banks of landing lights, located north, northeast and south.

An unusual feature is in the boundary lights, which consist of three green approach lights at each end of each runway. Landing light is provided by three banks of four 1500-watt, 32-volt floodlights, located in the north, northeast and south. The lights are so spaced that a pilot will land over and behind a light when coming in from any direction.

The upper southeast tower room houses the controls, which are mounted on ebony asbestos panel 24-inch by 36-inch. All controls are at one's finger tips and are small 220-volt toggle switches, which in turn energize magnetic switches which operate the floodlights and all other electrical equipment.

An illuminated wind tee in the form of a small airplane is located on the hangar roof. The rotation of this wind tee indicates on the control board which light should be turned on for a plane to land and makes it unnecessary for the operator to determine wind direction. The wind tee is mounted on roller bearings and will revolve in a wind not strong enough to be indicated on a wind duct.

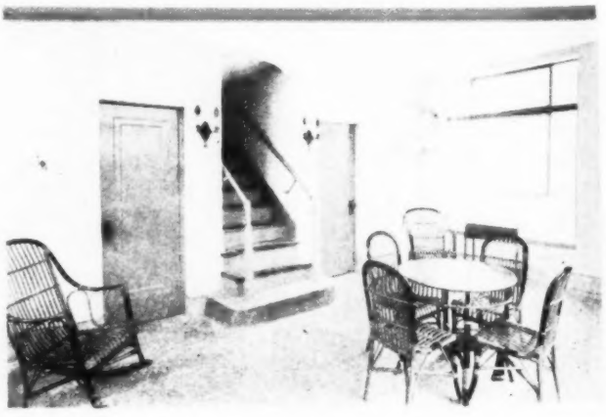
The hangar building is made of brick and steel and has a clear floor space of 106 feet by 120 feet, with 20 feet clearance to the lower truss members. It will house twenty average size airplanes. However, during a recent celebration there were actually stored in the hangar one trimotor and eighteen small ships. In addition to the airplane storage space, there are eight 20 feet by 20 feet rooms and shop space 20 feet by 80 feet. The 20 by 20 rooms, arranged as shown in the pictures, contain the electrical control room, heating plant, rest room and offices. An artistically fitted rest room is provided for aerial travelers.

The floor of the hangar is waxed and polished and has the appearance of a ballroom floor. This treatment of the floor is maintained to prevent oil from airplane motors soaking in and spotting the floor.

The service station is of brick and steel and a miniature duplicate of the tower room. It houses the manifold, pump and motors necessary in discharging gasoline to the two air, water and gasoline pits, which are located directly east of the hangar and on the edge of the north and south runways.

There are no obstructions within 800 feet of the boundary of the airport, all telephone, telegraph and power lines being dead-ended at that distance, then laid underground to the airport hangar.

General Fechet commented upon this port by saying that there were more expensive ports, but that there were not better landing areas any place in the United States and that no town the size of Ponca City can claim as good a port.



The rest room.

Piston Actuated Gear Valves Operate Differential Control

By M. A. ABERNATHY, *General Supt. Transmission Lines, United Gas Corp.*

WHILE considering the design of a measuring station for an installation where the flow of gas varied from 5 MCF to 2,000 MCF per hour the basic idea for the following described new type of differential control was originated. The purpose of the control, as the name implies, is to confine the differential in a multiple tube orifice meter installation within certain predetermined limits. This result is secured by utilizing the differential created by the flow through the orifice to apply the pressure of the gas in the main line to the opening, or closing, in succession of the upstream valve in the meter tubes, as the differential reaches the upper or lower limit, thus keeping in operation the correct number of tubes to accomplish the desired result.

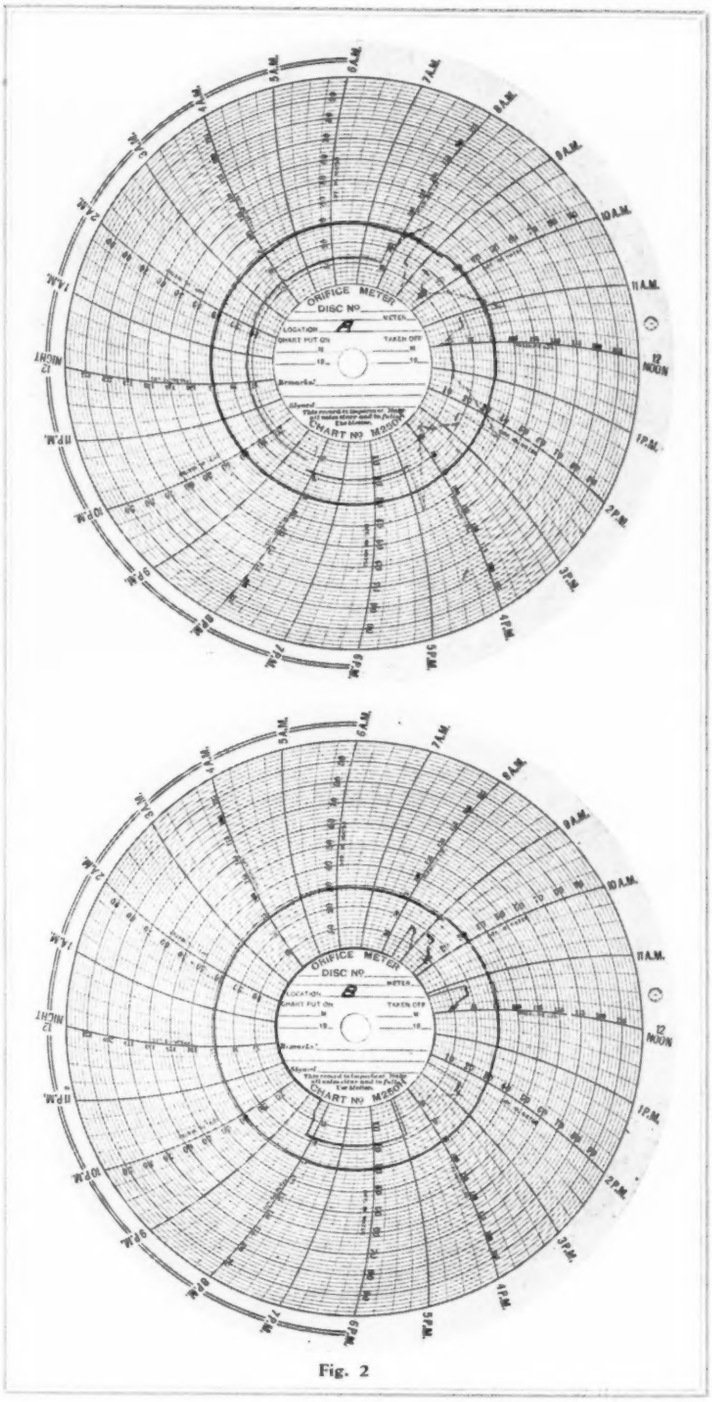


Fig. 2

The primary considerations in the design of the control were, that it should be positive in operation, and that the liability of leakage through the closed valve should be reduced to a minimum. To comply with the first consideration, it followed that the control must be simple in construction, require little maintenance, that the moving parts be few in number and designed with a high factor of safety, and that ample force be provided to secure the result under any operating conditions which might arise. After considering these factors, it was decided to utilize the pressure of the gas rather than electrical devices, or similar apparatus, to supply the actuating force required to manipulate the valves.

The control consists of a "U" tube containing floats and float guide rods on which are mounted upper and lower adjustable stops, a four-way pilot valve, a double-acting pressure cylinder, a meter tube valve, and a gear assembly connecting the cylinder to the meter tube valve; with the proper piping from the meter taps to the "U" tube, from the gas supply to the pilot valve, and from the two discharge ports of the pilot valve to the top of reservoirs partially filled with oil (the oil reservoir being provided to keep the cylinder filled with oil, thus insuring proper lubrication of the cylinder), with oil connections from the bottom of each reservoir to opposite ends of the double-acting pressure cylinder. In each of the two lines between the pilot valve and the oil reservoir is a small vent and between the oil reservoir and the pressure cylinder is a valve for controlling the time required to open or close the meter tube valve. The pilot valve is mounted between the two columns of the "U" tube directly above an extension of the piston rod of the pressure cylinder. The arm mounted on the pilot valve stem is connected to each of the float guide rods by an identical system of links and levers.

In operation, the stops on the float guide rods are adjusted to the desired differential range. As the differential changes, the floats move freely on the float guide rods until they strike the upper stop in one column and the lower stop in the other column. The force created by the buoyancy of the float on the one side, plus the weight of the float on the other, moves the float guide rod, which movement is

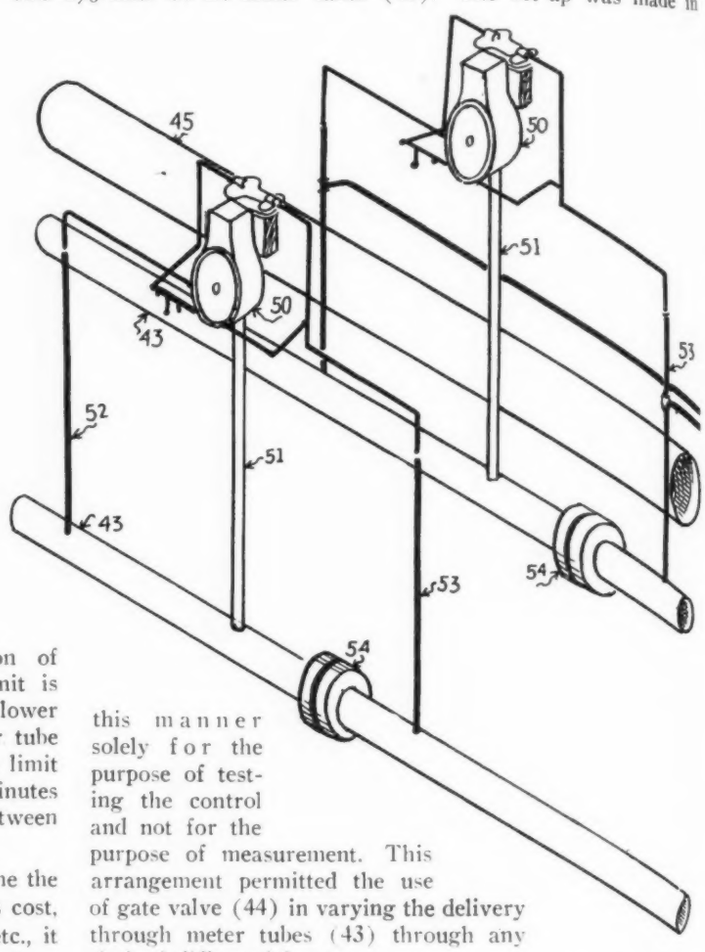
transmitted through the system of links and levers to the arm on the pilot valve, thus opening the pilot valve and permitting main line gas pressure to be exerted on the oil reservoir from whence it is transmitted to one end of the pressure cylinder. The consequent movement of the piston is transmitted to the meter tube valve stem by the gear assembly, thus opening or closing the valve, depending upon the direction of movement of the piston. At the instant the pilot valve opens in either direction, a pawl, mounted on the pilot valve assembly arm, engages a stop, thus holding the valve in the open position, irrespective of any change in the differential, until the piston approaches the end of its stroke, when a lug, mounted on an extension of the piston rod, first disengages the pawl so that the pilot valve is free to close, or to rotate in the opposite direction when the differential changes to the opposite limit, then forces the pawl against a stop mounted on the pilot valve assembly arm, thus returning the valve to the closed position as the end of the stroke is reached. When one port of the pilot valve is open to the gas supply, the other port is exhausting to the atmosphere, so that when pressure is being transmitted to one end of the cylinder, the pressure is relieved on the opposite end, thus preventing the pressure equalizing in the double-acting cylinder. When the pilot valve is closed, the gas in the line between the valve and the reservoir escapes through the vent in this line, thus removing the pressure from the cylinder. This vent also prevents pressure building up in either line, if there should be leakage in the pilot valve. The pilot valve is designed so that the direction of rotation when the differential reaches the upper limit is the opposite of the direction when it reaches the lower limit. The time required for the valve in the meter tube to open or close after the differential has reached its limit may be varied from 10 seconds to as much as 5 minutes or more if desired, by throttling valves in the lines between the oil reservoir and the pressure cylinder.

After considering the various factors which determine the choice of the fluid to be used in the "U" tube, such as cost, effect of evaporation, effect of temperature changes, etc., it was decided to use either a light gravity lubricating oil or commercial mineral seal oil. After taking into account the specific gravity of the fluid, the force required to operate the pilot valve and the design of the system of links and levers, the diameter of the float was determined to be approximately 12 inches. A sealed float is used for installations where the line pressure will not exceed 100 pounds and a vented float is used where the line pressure is in excess of 100 pounds. The height of the "U" tube is governed by the differential range desired and the type of float used, and is varied to meet the conditions of each particular installation. The vented float increases the required height of the "U" tube, as the vent must be carried far enough above the fluid to prevent any danger of the fluid getting into the float. On account of this feature, we are working on a design to utilize a sylphon bellows in place of the "U" tube for installations where the line pressure will exceed 100 pounds. We have not yet made any tests of this design, but, at this time, it appears that it will be satisfactory.

The diameter of the pressure cylinder is, of course, determined by the gas pressure available and by the force required to manipulate the meter tube valve, and is varied to meet the conditions of each installation. The control may be applied to either a gate valve or a plug valve.

The space required for the installation of the control is approximately 4 by 8 feet, though if desired this space may be reduced by placing the "U" tube immediately over the meter tube.

Figure 1 shows the control as installed at Latex Station in Louisiana for test purposes. The installation was made on a 12-inch low-pressure field line at a point about 2,000 feet from the compressor station by welding in a header on each side of gate valve (44) in the 12-inch line and then connecting the headers with the two 6⅝-inch O. D. meter tubes (43). The set-up was made in this manner solely for the purpose of testing the control and not for the purpose of measurement. This arrangement permitted the use of gate valve (44) in varying the delivery through meter tubes (43) through any desired differential range.



Valve (46) is a standard 6" gate valve, while valve (4) is a 6" venturi type plug valve, the latter valve being the one operated by the control in this particular installation. (16) represents the rack and quadrant by means of which the force from the pressure cylinder (3) is applied to the opening and closing of the plug valve.

Columns (25) and (26), connected by line (36), form the "U" tube of the control, and lines (27) and (28) leading from the orifice meter connections in meter tube (43) nearest the 12" field line and entering flanges at top of columns form the differential connections for the control.

The floats are shown at (31), the float rods at (29), and the float rod guides at (23). The pilot valve is indicated by (2), and the pilot valve arm assembly by (7) and (9). (22) shows the oil reservoirs connected to the pressure cylinder, while (42) is the fluid supply reservoir for the "U" tube. (This reservoir is isolated by a suitable valve except when fluid is being added to or removed from "U" tube). Line (47) is the supply gas to the pilot valve, while lines (20) and (21) connect the pilot valve to the pressure cylinder through oil reservoirs (22).

Figure 2 shows typical charts from the installation represented in figure 1. Chart (A) is from the meter on the tube nearest the 12" field line or the tube supplying the

actuating differential for the control, while chart (B) is from the meter on the tube to which the control is directly connected. These charts were made with the control set to open the plug valve when the differential in the meter tube nearest the 12″ field line reached a value of 40 inches, and to close this valve when the differential decreased to a value of 5 inches. It will be observed that as the differential on chart (A) reached 40 inches the valve in the meter tube direct-connected to the control opened, thus putting both meters in service, with the differential equalizing at about 18 inches when no change was made in the setting of valve (44) after the control had operated. As the flow through the two meter tubes decreased and the differential dropped to 5 inches, the valve in the meter tube connected to the control closed, thus leaving one tube in service.

While the control was set to operate at a differential of 40 inches at the upper limit, it will be observed that the differential in some instances reached a value of almost 41 inches before falling. This was caused by the rapid rise of the differential and the time interval between the opening of the pilot valve and the opening of the main valve. The time interval in this case was set at 20 seconds. This discrepancy is not so apparent at the lower limit of operation as variations in the rate of flow do not affect so rapid a change in the differential.

In the installation shown in figure 1, only two meter tubes are used, one tube remaining in service at all times with the other tube in or out of service depending upon the differential acting on the "U" tube of the control. It should not be assumed that the application of the control is limited to any definite number of meter tubes, for the design to care for the measurement condition under which work on the control began, called for the use of a total of five meter tubes during peak delivery, with four tubes out of service during the period of minimum delivery. The installation of five meter tubes was worked out so that the control on No. 2 tube received its actuating differential from tube No. 1; the control on No. 3 tube received its actuating differential from tube No. 2; the control on No. 4 tube received its actuating differential from tube No. 3; and the control on No. 5 tube received its actuating differential from tube No. 4. This arrangement allowed No. 1 tube to take care of the minimum delivery through the measuring station.

This method of obtaining the actuating differential for the controls determined the order in which the tubes were to be put in service, and the order in which the meters were to go out of service was determined by adjustments on the stops within the control "U" tubes. The stops were arranged to put the tubes out of service in the reverse order in which they were to go into service by setting the control on No. 2 tube to shut off at a lower differential than No. 3 tube; No. 3 tube to shut off at a lower differential than No. 4 tube; and No. 4 tube to shut off at a lower differential than No. 5 tube. The proper selection of orifice plates for the meter tubes will enable this order of events to occur.

The control is particularly applicable to town border measuring stations and to certain types of industrial plant measuring stations, such as electric power plants, brick plants, etc. It is also applicable to measuring stations at connections where it is desired that the normal rate of flow should be very small, but is desired that a large volume of gas be automatically available for use during abnormal load conditions, or in emergencies caused by failure of other sources of supply.

Fred M. Lege, Jr., originated the idea and made the first drawings of the control. The work involved in the completion of the design from the original drawing and the testing of the apparatus were done largely by Joe J. King, with A. L. Bradford rendering valuable assistance and with some contributions from the writer.

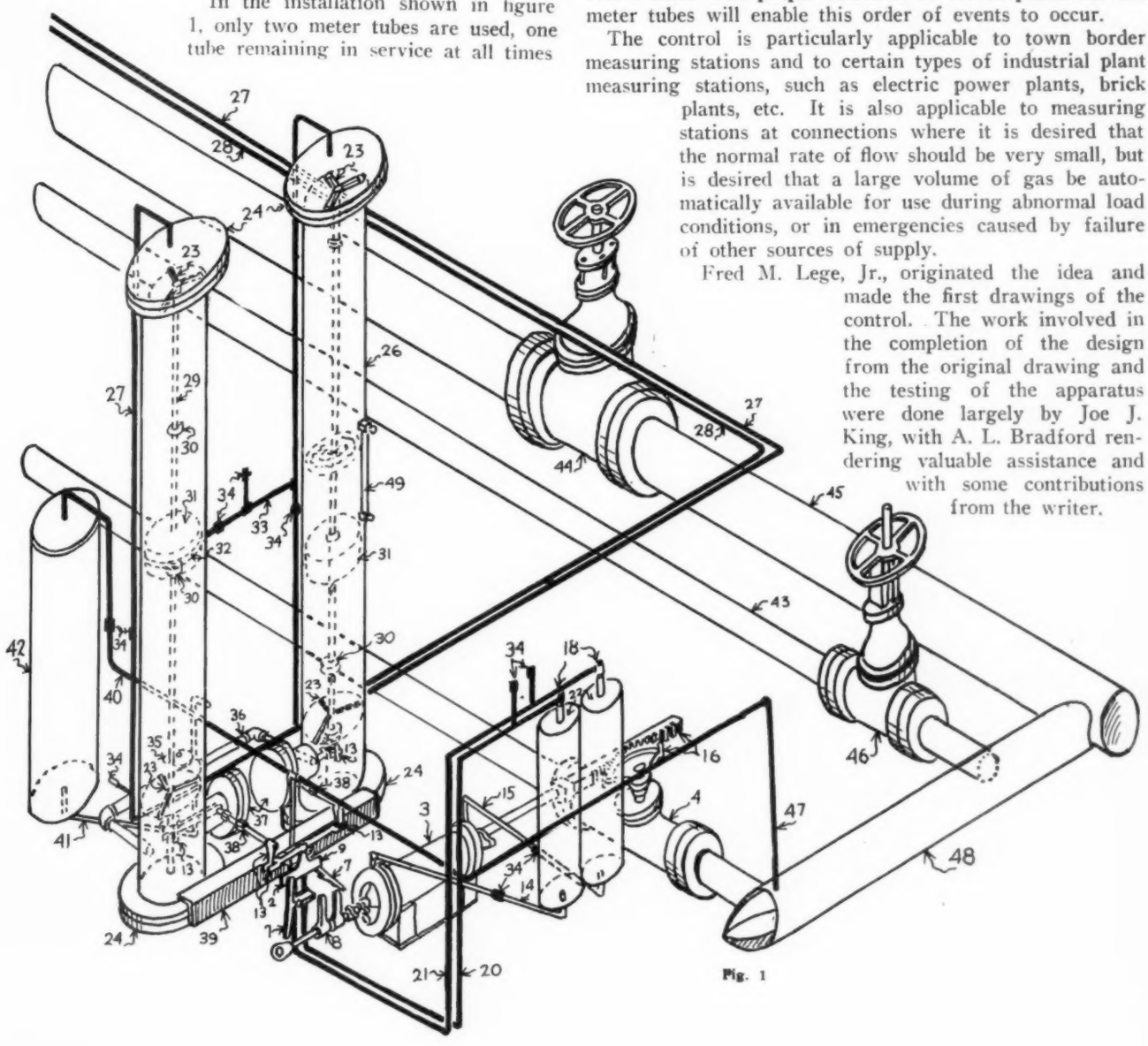


Fig. 1

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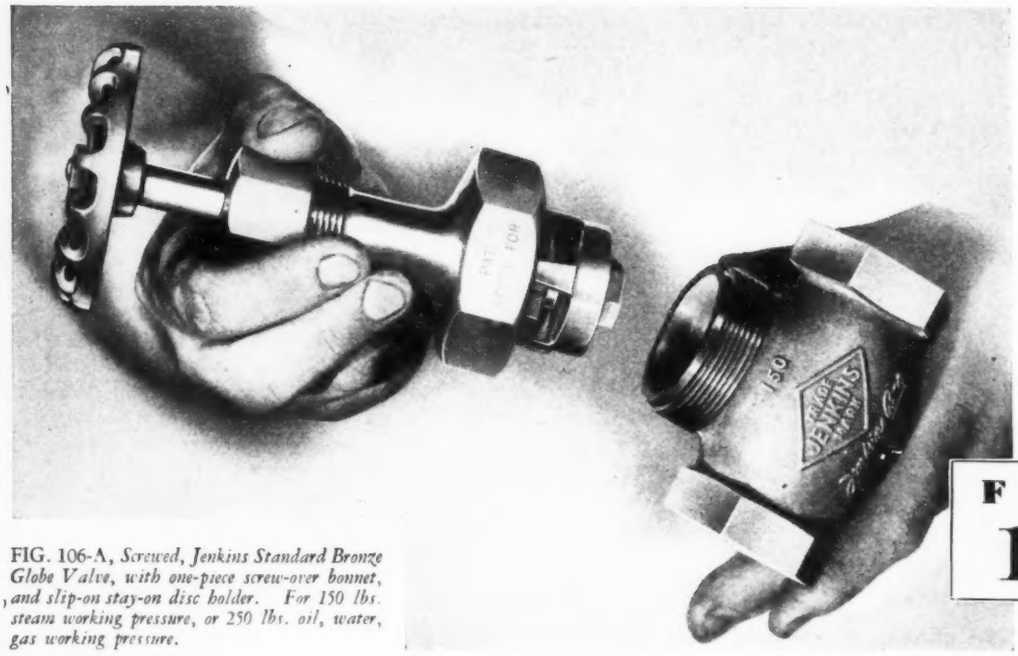

FIGURE 106-A

FIG. 106-A, *Screwed, Jenkins Standard Bronze Globe Valve, with one-piece screw-over bonnet, and slip-on stay-on disc holder. For 150 lbs. steam working pressure, or 250 lbs. oil, water, gas working pressure.*

Note the finely finished screw-over bonnet that is made from a single piece of selected Jenkins Valve Bronze.

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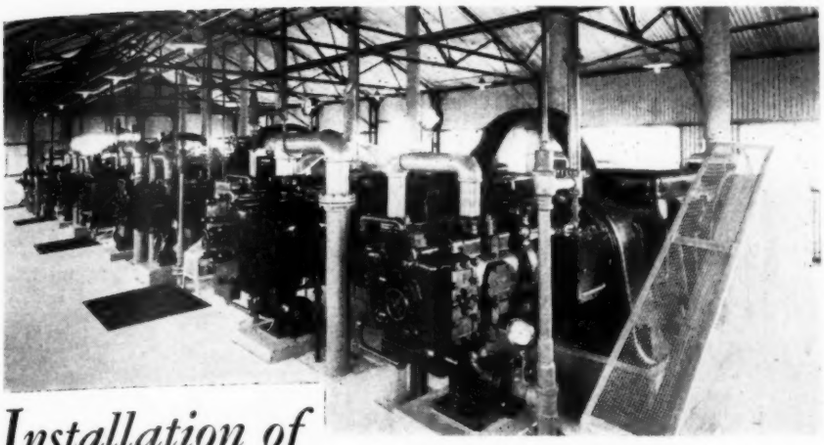


Cooper-Bessemer equipment on the T. B. Slick Hoopes lease at Oklahoma City.

Installation of Compressor Cylinders Furthers the Use of High Pressures in Gas-Lift Work

THE gas-lift method of producing oil has been developed to a high degree of efficiency in recent years, but new fields bring new problems. For example, the Oklahoma City field—with its deep wells.

Much experimentation with gas-lift as applied to deep producing wells has taken place recently in the Oklahoma City field and several new ideas and new types of equipment have been promoted as a result.

High pressure cylinders, relatively speaking, were already familiar to users of compressors for gas-lift work; but the range of pressures in actual use has never much exceeded 1,000 pounds to the square inch. An installation of compressors for gas-lift work at Oklahoma City has recently been made that calls for the raising of pressures to a much higher degree.

The T. B. Slick Company, with eight wells on its Hoopes lease, producing from an average depth of about 6,400 feet, has installed some special compressor equipment. Gas-lift was decided upon as the best means of controlling the gas-oil ratio and of increasing the daily and ultimate recovery of crude oil, after the natural flow had reached a stage of undependability.

A pair of special, all-steel, compressor cylinders were designed and built, capable of holding 2,000 pounds pressure to the square inch by one of the large compressor engine manufacturers for installation on this lease. These compressor cylinders were then direct-connected to a standard gas engine.

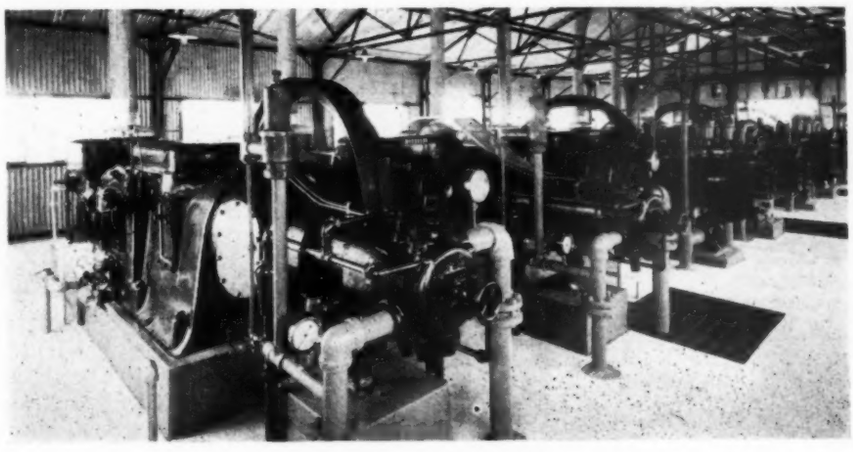
Meanwhile, preparations were made for the erection of a gas-lift plant to be located in the center of the lease. Foundations were laid to accommodate four 2-cycle compressor units as follows: Three 200 brake horsepower, twin type, each equipped with 14¼x6¾x20-inch regular 1,000-pound compressor cylinders; and one 200 B. H. P. twin, with 5½x5½x20-inch special 2,000-pound steel compressor cylinders.

The installation was designed to handle two or three wells, depending upon the volume of gas required to flow each well. This was figured at from 1,000,000 to 1,250,000 cubic feet in 24 hours. The first job of the new plant was to kick off a well that had not been flowing.

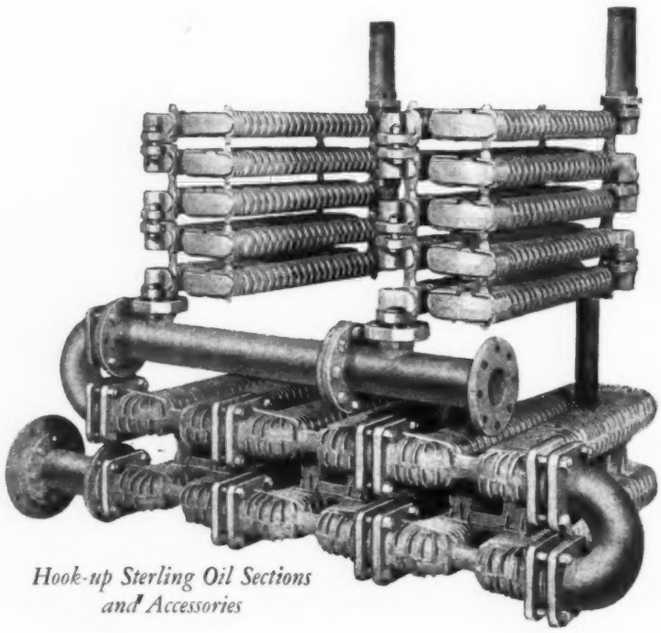
When kicking off a well the three regular units operate at no pressure on the intake and 400-500 pounds discharge pressure. Then, this discharged gas is sent to the special unit which has an intake at 400-500 pounds and whatever discharge pressure is necessary up to 2,000 pounds. In an emergency, this discharge pressure can be built up to 2,500 pounds, momentarily.

As soon as the well begins flowing, the special unit may or may not be shut down, depending on the flowing pressure required. If the excessive high pressure is not needed for flowing, the wells are produced directly from the three regular units at whatever operating pressure is necessary to maintain steady production. But should a high pressure be needed for keeping the wells flowing the special unit can at once be used for this purpose as well as for kicking off.

As it becomes desirable to apply gas lift to more and more wells on the lease, the plant can be extended to accommodate additional compressors, regular and special high pressure units in each group bearing the same relation to each other as they do in the original installation.



Another view of Cooper-Bessemer installation at Oklahoma City.



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Safety IN Gasoline Plants

By C. L. HIGHTOWER[1]

IN THE infancy of the natural gasoline business several serious explosions and fires were experienced with resultant loss of life. The widespread publicity given these so-called catastrophies created the impression, both in the oil industry and in the public mind, that natural gasoline manufacturing was the most hazardous operation of the industry and that a gasoline plant was a place to avoid.

Such fires and explosions still occur occasionally and there is no denying that a gasoline plant offers potential fire and explosion hazards. However, it has been conclusively proven in recent years that this branch of the industry can be made just as safe or safer than any other by proper engineering practice and personnel training.

The Petroleum Section of the National Safety Council, in reporting on the results of the 1930 Petroleum Section Contest, gives the frequency rate (number of lost-time personal injury accidents per million man hours exposure) for all departments as 17.55, while Natural Gasoline shows a rate of 10.74. A large majority of oil companies were entered in this contest and the experience as indicated by the above figures is representative of the accident situation over the entire country.

Engineering perfection has not been attained in the design and construction of gasoline plants and plant equipment and many accidents can yet be attributed to inefficient engineering practices. Much progress has been made, however, and I think we can safely say that we have developed our machinery and equipment faster than we have trained our personnel, particularly with reference to accident prevention.

Practically all plants constructed in recent years embody the most advanced engineering features. The "layout" provides for the boiler installation at a location well removed from the compressor room and plant proper. Conduit installation of wiring, vapor-proof globes, and switches removed from probable gas areas are likewise required in modern plant construction.

Some of the other less outstanding hazards are not so effectively guarded against, however. As an example, a pump, used to move gasoline from the storage tanks into the loading line, was installed in a sump pit inside a small pump house. Like most all pumps, it required frequent repacking and a man entering the pit for the purpose of repacking the pump stood a good chance of being overcome before the job was finished. Certainly a great fire hazard existed by the escape of gasoline vapors and their accumulation in such a confined space. The occurrence of a fire with a man in the pit would very likely have resulted in a fatality.

Where a slip may mean a scald. A pipe makes a poor working platform anywhere.

A man doesn't have to get down on his knees or do a lot of stooping to work on these pumps. They operate just as efficiently on a raised foundation and are certainly easier to work on.

A practice not uncommon in gasoline plants is that of increasing the pressure on lines and fittings in excess of that for which they are designed. Where a change in operation makes it necessary to increase the pressure on a given piece of equipment, it should first be determined whether or not it will safely carry the increased load.

A fitting with working pressure of 250 pounds provides for a factor of safety sufficient to take care of a reasonable increase in pressure due to emergency or unusual conditions, but it certainly is not safe to carry a 400-pound working pressure on a 250-pound fitting. Many fires can be traced to failure of equipment due to just such practices.

All fittings, especially those

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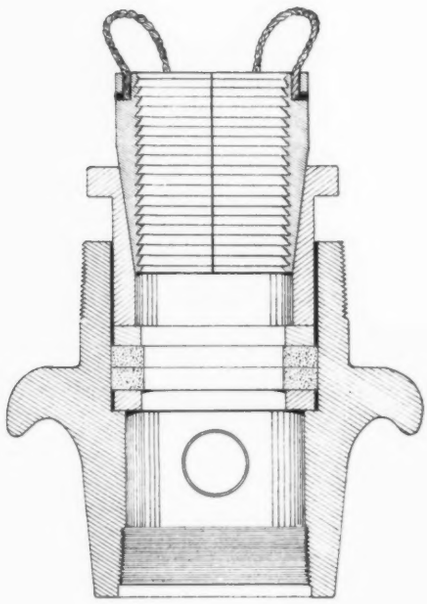
THIS two-section type Casing Support and Packing Head with Casing Elevator lifting lugs and solid top section connected together with heavy bolts or clevis, is designed to hold and suspend long strings of casing and trap and retain fluid and gas between the casing suspended and larger size casing into which the head is connected. Thus excessive pressures can be regulated through the side openings into which flow or lead lines are connected.

The well casing is held straight in the wedges from which it is suspended, thus facilitating the easy starting in the process of pulling the well casing from the hole without the aid of special cut nipples.

Wild Well Subduer



THIS two-section type Casing Support and Packing Head with Casing Elevator link lifting lugs and threaded extension on the top section provides a means of connecting thereto, well casing and valves for affecting control of wells that blow out and become wild when excessive pressures are encountered in the process of drilling or when equipment fatigue limits are exceeded.

Kantspread Support

THIS two-section type Casing Support and Packing Head with Casing Elevator lifting lugs and split top section can be instantly installed or removed for the introduction into the stationary string of set well casing, drill pipe, tubing or other well casing and emergency installations.

Setting and suspension of well casing can be adjusted and controlled without the aid of nipples or without releasing weight tension of well casing as it is being lowered.

Ordinary operating crew can handle and set both split halves of top section in engaging position.

Packing Mechanisms Are Positively Accurate In Operation
Maximum Internal Diameters

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working under high pressure, should be inspected regularly and replaced when corrosion becomes evident. Equipment handling oil or gas with sulphur content is likely to be affected much sooner than that not so used, and should be given particular attention.

Three men were burned to death in a fire following the rupture of a tank containing gasoline. The tank in question was being used as a receiving tank in a treating unit. It was of light construction and either was inadequately vented or not vented at all. The accident occurred on a warm spring afternoon and it is supposed that the high gravity product built up excessive pressure due to heat from the sun's rays and not having an outlet except through the flow line leading into another tank, it ruptured. Welding work was in progress a short distance away and the gasoline was thrown on the welder and two other men who were passing the tank at the time. The welder's torch was the source of ignition and the men were fatally burned before the fire was extinguished.

Tanks constructed so as to withstand the pressure required of them, only should be used in and around gasoline plants and all vessels and other equipment under pressure should be adequately vented.

Welding work is frequently required in connection with new construction or maintenance at a plant, but if possible, the equipment to be worked on should be dismantled and carried outside the plant yard. When it is impossible to do this, extra precautions should be taken to see that the area where the welding is to be done is free of gas or vapors and that the equipment to be welded is thoroughly washed and steamed.

The crystallization of a bolt on the cross head of a gas engine in one plant resulted in serious damage to the engine and came near injuring the operator.

When the crosshead bolt on one side broke, the operator ran to the engine and shut off the gas supply. The fly wheels, of course, continued in motion, and when the second crosshead bolt broke, permitting the connecting rod to swing over and catch on the engine frame, the fly wheels twisted off the shaft and burst. The roof and the wall in the rear of the engine was ruptured in several places by pieces of the fly wheels which were hurled in all directions with considerable force. The operator who was standing a short distance away, narrowly missed being struck and the plant was shut down for over a week.

This experience indicated the need for periodic replacement of bolts and other engine parts subject to continued strain, as they are more likely to crystallize.

The advisability of having a control valve on the fuel supply line outside the engine house is also pointed out in this case. Automatic "cut off" equipment is more practical and safer, but plants that are not so equipped, should at least have a control point outside the engine house.

Whether or not a plant is of recent construction, a "check up" on such conditions as described above would likely result in finding some serious hazards requiring correction.

Quite often, a man's close contact and familiarity with the plant is a hindrance in his efforts to locate and remove physical hazards and they are permitted to exist year after year. Because no fires or accidents have occurred under given operating conditions is no indication that the plant is immune and a periodic "check up" of equipment, as well as methods is advisable. This "check up" can best be made by someone who is not in daily contact with the plant, but it should be made by someone thoroughly familiar with gasoline plant operations, and preferably someone who is connected with the natural gasoline department, as safety is an operating problem and should be so handled.

All fittings should be carefully checked for signs of weakness or sand holes before being placed in service.

Accidents occurring from the failure of equipment or other such physical hazards are likely to be serious, but the frequency of such accidents is not so great. A large majority of gasoline plant accidents are traceable to unsafe practices on the part of the personnel.

Construction and maintenance work unquestionably contribute the largest share. A construction job is usually conducted with as much speed as possible, and quite often the work is started before the proper preparation is made and necessary tools and equipment secured. Effort is usually made to cut down all possible expense, and improvised working platforms are used instead of providing safe scaffolds, etc.

A case is recalled where one man suffered fatal burns when just such a practice was followed. A pipe connection was being made over a hot well, and supposedly to save time, two 2-inch pipes were placed over the well to serve as a working platform. The pipes spread during the course of the work, and one of the men fell into the scalding water, sustaining burns from which he later died.

In the rush of construction work, inexperienced men are frequently used, and are often started on the job without any instruction as to safety.

That accidents are just as unnecessary in construction work as they are on regular operations has been definitely proven by the building trades. The largest hotel building west of Chicago, was completed recently in San Francisco, without a fatal or serious accident. Accidents can be as effectively controlled on construction work in gasoline plants or anywhere else as they were controlled in the building of this hotel.

Accidents involving members of the regular maintenance and operating crews of a plant result largely from chance taking, as the men are usually experienced and familiar with the routine hazards of the work.

The practice of doing chipping or grinding work without goggles is responsible for ninety-five per cent of the eye injuries. There are few plants but that are supplied with eye protective equipment, and neither the plant foreman nor the workman is sufficiently impressed with the need for them when such work is performed without the protection.

The yearly accident report of most any plant reveals many cases of skinned knuckles, broken hands, etc., due to the use of improper or defective tools. A wrench is used as a hammer, a burred chisel is employed in cutting work, or a hammer with a splintered handle is used. Each case is inexcusable, and certainly preventable by proper attention to the job requirements and the condition of the tools.

A few accidents occur from fooling or horseplay, such as a man playfully throwing a wrench at another or two men scuffling together. Most workmen of today have come to realize, however, that the plant is not a playground, and act their ages on the job. A gasoline plant or any other unit which completes a year or two years without a lost-time accident does so because every last man, from the Superintendent down, is sufficiently impressed with the need and benefits of safety, and is constantly and conscientiously trying to eliminate accident-causing conditions. The personnel has developed a safety consciousness.

Smoking at the boiler house is a bad practice. A man's likely to forget and saunter down to the plant with a lighted cigarette or pipe in his mouth.

However, Safety may be considered an individual problem—it is distinctly a responsibility of the supervisory force to develop that spirit of co-operation and loyalty which is the foundation of a good "No Accident" record.

The plant foreman who exercises diligent care in the selection and placement of his men, impresses upon them from the start the need for Safety effort, furnishes proper tools and equipment to work with, develops a co-operative spirit among the personnel; and last, but not least, sets an example of safety himself, simply will not have any accidents.

The increased efficiency by reason of this effort on the part of the supervisor will be reflected in the production curve.

New Officers for Gasoline Association

M. H. Kotzebue

M. H. KOTZEBUE, Tulsa Boiler and Machinery Co., Tulsa, has been elected president of the Natural Gasoline Supply Men's Association. Mr. Kotzebue succeeds M. F. Waters of Hanlon-Waters, Inc., Tulsa. Mr. Waters was elected treasurer of the association for the coming year.

Other officers elected at the meeting of directors were: A. J. Kerr, Pittsburgh Equitable Meter Co., first vice-president; A. W. Burkett, Jackson Engineering Corp., second vice-president. Ray E. Miller, secretary of the Natural Gasoline Association of America, with which the supply men's association is affiliated, was elected secretary.

A. J. Kerr

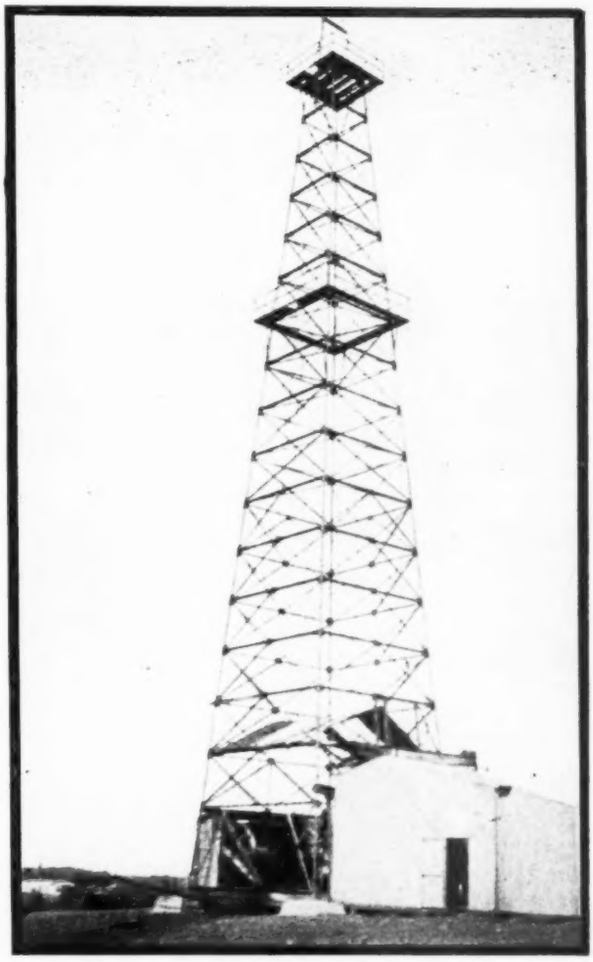
A. W. Burkett

M. F. Waters

56 out of 61

Sinclair Oil and Gas Co. Wells in the Oklahoma City Field Drilled with 12x12 IDEAL-AJAX Roller Bearing Piston Valve Engines. . . . . .

Average Depth of 61 wells to casing point	6500 ft.
Average drilling days for 61 wells	67 days



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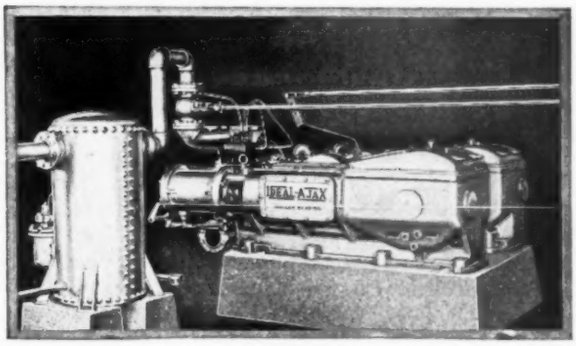
ROLLER BEARING STEAM DRILLING ENGINES



IDEAL-AJAX 12x12 Roller Bearing Piston Valve Engine with extra heavy, large-capacity Steam Separator.

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AJAX IRON WORKS, Corry, Pa.

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The Use of Filter Aid in » » »

Dewaxing Lubricating Stocks

THE use of a filter aid in dewaxing lubricating stocks, originated by James V. Weir, of California, has recently been receiving considerable attention from the refining industry. It is known that at least three commercial plants are in operation and a fourth contemplated. Reports on the success of these plants are varying. The process involves the use of a material comparatively new to the industry and from all accounts much has to be learned of its characteristics. Actual operating data available are meagre, which condition can be attributed to a general reluctance on the part of the refiners operating these plants to publish information on a, as yet, new and untried process.

Realizing these conditions, an attempt will be made to outline in this article some of the principles involved in filter aid dewaxing. A description will be given of the equipment necessary for carrying on experimental work and an outline of the accepted technique employed in this experimental work. The sources of this information are numerous, no information relative to any one plant is intended and no specific references are made. As is widely known the Weir Process consists of mixing a chilled solution of Naphtha (or other solvent) and the oil to be dewaxed in varying amounts (40 per cent to 60 per cent Naphtha), mixing the solution with a filter aid and filtering this slurried mixture. The presence of the filter aid permits the formation of a porous filter cake (a mixture of wax and aid) rather than a highly impervious wax cake such as is encountered in the old style cold presses. The wax-free filtrate is topped and the wax-free low-pour test oil results.

Courtesy Texas Flying Service, Inc.

Panhandle Producing & Refining Co.'s Wichita Falls plant from the air.

Auxiliary equipment consisting of washing apparatus for the filter aid, drying equipment for the removal of accumulated moisture in the filter aid and, if the nature of the oil processed requires it, a burning kiln for periodic revivification. A refrigerating plant is required for the chilling with sufficient surface so arranged as to permit close regulation of temperature decrement.

In order to intelligently approach the design of a Weir plant, the characteristics of the stock under varying conditions of temperature, cel dosage, wax content and other contributing factors must be studied in detail. The equipment necessary for such work is outlined below, followed by a resumé of the technique required for consistent duplicable results. If these results are desired for preliminary information only, and not design, the equipment can be simplified to a great extent.

Solution Chilling Tank—The chilling tank should be of at least ½-barrel capacity, well insulated and equipped with a power-driven agitator (preferably air-driven).

A jacketed tank, expanding ammonia in the jacket is considered the most flexible arrangement, although if brine is available easier temperature control can probably be maintained.

A special coil immersed in the solution through which ammonia is expanded, or brine circulated, will answer the purpose though not as satisfactorily as the jacketed chiller. Agitation of the solution is necessarily mild and any equipment giving this degree of stirring is satisfactory. Provision must be made for taking temperatures of both the chilled solution and the chilling medium. A convenient method of emptying the tank is required and a wooden cover to exclude air, thus preventing condensation of atmospheric moisture in the cold solution.

Naphtha Chilling Tank—A chilling tank for naphtha is required, approximately the same capacity as the solution chilling tank. Rate chilling is, of course, not required here, neither is the agitator necessary. It should be possible, however, to regulate the final temperature from 30 degrees F. to 0 degrees F.

Filter Surface—The experimental filter surface used most widely is the single leaf of from 0.7 sq. ft. to 1.0 sq. ft. in total surface. The construction is of metal throughout with a ⅛-inch standard pipe connection for the vacuum line. The cloth backing is a screen of No. 8 wire with about ⅛-inch square openings. This frame is covered with the type of cloth found by trial to be the most suited to the conditions.

Filtrate Receiver — A vacuum type filtrate receiver is required of from 1,000 to 3,000 c.c., graduated in such a manner as to be easily read and preferably of glass, so that the operator may tell at a glance how much filtrate has been picked up.

Vacuum Pump—The ordinary laboratory vacuum pump such as the Genco (Hy Vac) has sufficient capacity for the work although a larger pump would permit the use of several filter leaves simultaneously.

Miscellaneous Equipment—In addition to the foregoing, general laboratory supplies, such as thermometers, rubber hose, stop watch, spatula, balance and graduates are needed.

Before outlining the experimental technique it is well to consider what factors affect filtration with a filter aid.

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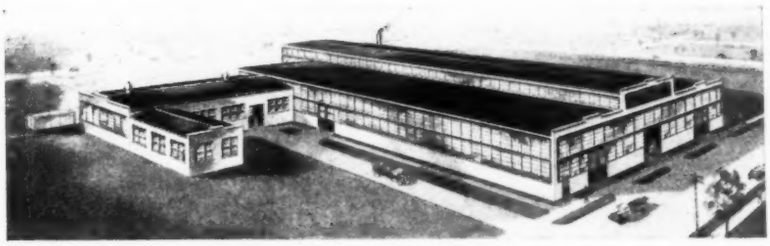
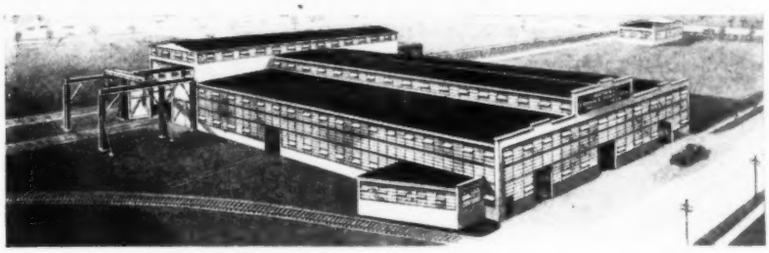


HOUSTON PLANT



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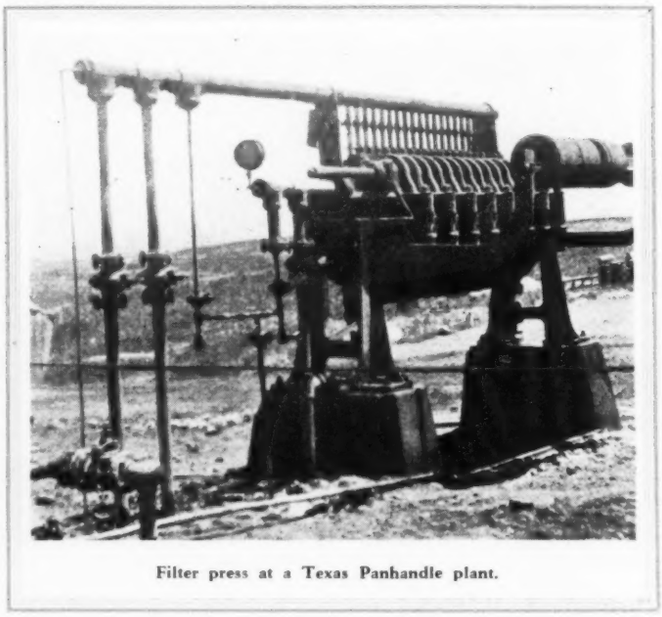
When writing MIDWEST PIPING & SUPPLY CO., INC., *please mention The Petroleum Engineer*

Below is noted a list of them. No attempt is made to put them in the order of their magnitude or importance.

1—Viscosity of stock.
2—Wax content of stock.
3—Color of stock.
4—Cloud point of stock.
5—Cold test of stock.
6—Melting point of wax.
7—Crystal forming characteristics of wax.
8—Solubility of wax in naphtha.
9—Cel dosage in pounds per barrel.
10—Per cent dilution (viscosity at filtering temperature).
11—Character of diluent.
12—Differential pressure through cake.
13—Filtering cycle (time in seconds pickup).
14—Efficiency of recovered aid.
15—Rate of chilling solution.
16—Temperature of filtration.
17—Per cent moisture in Cel.
18—Per cent of coloring matter or gums adsorbed by the filter aid.

In making the first determination on any given stock the per cent naphtha solution can at best be a guess unless considerable laboratory work is done beforehand. The optimum naphtha dilution is the one which gives the best cold test, depending on the solubility curve of the naphtha-wax solution and the one which gives the highest filter rate for a given temperature of filtration. In this latter case the viscosity of the blend is the controlling factor.

A generalization can be made from which initial dilutions can be determined later, to be increased or decreased in the actual filter tests. In the case of a light neutral being dewaxed (from 100 to 200 seconds at 100 degrees F.) from 40 per cent to 50 per cent naphtha has been found most desirable; for intermediate lubricating distillates (from 200 to 500 seconds at 100 degrees F.) 50 per cent to 60 per cent naphtha is the range in the case of bright stocks and cylinder stocks, about 70 per cent in the optimum.



Filter press at a Texas Panhandle plant.

After deciding on the trial dilution, the batch to be filtered is blended and placed in the chilling device, after having been heated to a temperature which will insure complete solution of the wax present. Refrigeration is applied in sufficient amounts to reduce the temperature of the solution from 3 degrees F. to 5 degrees F. per hour, over a range from 10 degrees above the cloud point of the oil to a temperature of 0 degrees F. The consensus of opinion seems to be that shock chilling below 0 degrees F. is not harmful to filter rates to any great extent. Contrary to the procedure set forth above, other refiners claim that in this process shock chilling can be done through the whole range with very little sacrifice of filter rate. This point has had considerable argument and support on both sides. It is recommended that test runs be made using both methods.

After the solution has been chilled to a point 20 degrees below the pour point desired, the solution is ready for the addition of the filter aid. A moisture analysis made with a Dean apparatus in 500 degrees F. end point kerosene should be made beforehand. Moisture content of the filter aid above 0.5 per cent is prohibitive, in that ice formation and moisture precipitation occurs with consequent leaf plugging. The optimum amount of filter aid required must again be determined by a series of runs as is the case of naphtha dilution. A generalization can be made for the three types of oils mentioned; however, a cel dosage of 20, 30 and 40 pounds of aid per barrel of solution, respectively, is a safe starting point.

After weighing out the proper amount of aid for the test sample, the aid is dumped into the chilled solution and thoroughly but gently mixed until a smooth, lump-free slurry is obtained. After further chilling in amount sufficient to offset the heating due to addition of the aid and the subsequent mixing, the slurry is ready for filtering.

The experimental filter leaf is dipped in a container of dilution naphtha which has been chilled to the same temperature as the solution. When thoroughly chilled, the vacuum hose is connected to the leaf and it is dipped into the chilled slurry. A stop watch is used to time the various parts of the complete cycle.

Determination of the filtering time must be made by a series of runs. Several factors enter into this determination, all of which will be discussed later. As can be expected, initial flow through the leaf is high and as the cake on the leaf builds up, the flow falls off rather rapidly after the first three or four minutes in vacuum filtration. In a pressure filter cycle the high flow period is, of course, longer. For a start a two-minute filtering cycle or pickup time is suggested.

At the end of two minutes the leaf is pulled from the solution and allowed to dry by pulling air through the cake. The solution sucked from the cake in this drying period should be segregated from the filtered solution as the cold test is liable to be higher. After a drying period of from 1 to 1½ minutes the leaf is dipped in cold naphtha and allowed to filter through about ½ to 1/3 as much cold naphtha as the volume of filtrate picked up initially. This cold naphtha washes the oil from the cake and supposedly leaves the wax in the aid. As before, the cold naphtha wash should be segregated. This segregation can best be accomplished by using three-stoppered graduates (2,000 c.c. each) equipped with a vaccum header and a cock for each, with individual vacuum lines from the graduates to the leaf. Following the cold naphtha wash is another drying period, the liquid from which is allowed to go into the liquid from the cold naphtha wash. After this drying the vacuum line is disconnected from the leaf, the leaf inflated gently with dry compressed air, and the cake, which is the filter aid and wax, scraped off.

After a series of runs, the adjustment of the various factors for a maximum yield of given cold test stock can be made, resulting in the highest filter rate with the lowest stock loss.

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Voltolization as a Factor in

Improving *the* Oiliness *of* Lubricants

By FREDERICK C. OTTO, *Consulting Engineer*

THE De Hemptinne patents which are basic for the process of treatment of oils by the silent electric discharge will all expire in 1932. The process has been controlled by the Rhenania-Oelwerke Stern Sonneborn of Germany. Considerable capital has been invested in European plants for the glow-discharge treatment of oils, known better as the Voltol process. In consideration of the expiration of the basic patents, it is expected that American oil technologists will show considerable interest in the possibilities of using the Voltol process for the producing of lubricants.

THE author of this paper has had more than twenty years' experience in the petroleum industry, in the manufacture and application of lubricants, as a chemist and an engineer. This article is of timely interest since much attention has been given to the subject of oiliness of lubricants during the past year.

Quality-Improvement of Lubricating Oils by Electric Treatment

Modern engines require lubricants entirely different from those used two decades ago. One of the most important characteristics of lubricating oils is the viscosity. In many cases modern engines demand oils of higher viscosity than used for the operation of older models. The petroleum refiner can easily meet demands as to increased viscosity. Experience has shown that viscosity is not everything. The term "oiliness" was introduced and some of the refiners and compounders improve the lubricating qualities of their oils by the addition of acidless tallow oils, lard oils, neatsfoot oils, castor oils, rape oils or by the addition of oleic acid, stearic acid, lead oleate, aluminum soap and similar agents designed to improve what is known as oiliness. A third method of improving lubricating oils is the silent electric discharge, also known as glow discharge or voltolization.

The Voltol Process

Among the different processes for the improvement of lubricating oils is one process which has attracted considerable attention. The process is generally known as the Voltol process and is based upon the discovery that hydrogen may be added to turpentine oil or to coal-tar benzol and other oils containing unsaturated compounds. Berthelot expressed his opinion that the action of the glow discharge resulted in the formation of polymers. Extensive research into the action of the voltolizing of oils has shown that the molecules of the treated oils undergo a rearrangement in the presence of rarefied gases expressed in an enormous increase in viscosity. For instance, a light neutral oil of 200 viscosity Saybolt at 100 F. increases in viscosity to 1500 Saybolt at 100 F. without materially affecting the oils as to their appearance. The increase in viscosity does not affect the fluidity of the oil at normal temperature.

The Basic Research Toward the Silent Electric Discharge

Berthelot has experimented already with the action of the silent electric discharge upon the constituents of organic compounds. Nernst has continued these investigations and has come to the conclusion that hydrogen atoms were split off from the molecules of the substances under investigation by collision with the gas ions and the new molecules thus formed were combined into larger molecular complexes. Alexander de Hemptinne put these experiments on a commercial basis; his patent claims almost everything that was later applied in the process known as "voltolizing." De Hemptinne proposed to start the voltolizing with a mixture of 50 per cent fatty oil and 50 per cent mineral oil and stepping up the mineral oil portion at intervals until a ratio of 15 per cent fatty oil and 85 per cent mineral oil has been attained. Hemptinne was able to increase the viscosity of a mineral oil from 6.5 Engler degrees to 12 Engler degrees at 122 degrees Fahrenheit.

The Voltolization of Straight Mineral Oils

The Oil Works Stern-Sonneborn, known internationally as "Ossag," acquired the Hemptinne process and spent considerable on research in order to modify the process in such a way that it would be possible to voltolize pure mineral oils without the addition of any fatty material. The result of all the research done and of the practical experience gained is that the voltolization of pure hydrocarbons for lubricating purposes is too slow to be economical. Ossag therefore has developed a certain method, consisting of voltolizing first a small amount of pure mineral oil until the gelatinizing point is almost reached, then withdrawing a certain amount of treated oil and adding an equal amount of fresh mineral oil, again voltolizing until the gelatinizing point is almost reached, again withdrawing a part and adding an equal part of fresh, untreated oil; this withdrawing, and adding to be continued until the desired amount has been thickened to the required consistency. This procedure has been applied especially during the World War, when fatty oil as starting agents were either not available or very scarce. It has been found that 70 Engler at 122 degrees Fahrenheit is the greatest viscosity that could be obtained in voltolizing pure mineral oils without gelatinizing.

The Voltolization of Mixed Fatty and Mineral Oils

As mentioned before, the original Hemptinne process was found to be expensive to operate. A step toward the final goal of mass production at low prices was found when the

Ossag improvement was applied to a compounded starting material. Rhenania-Ossag have used this further improvement in the following manner: The voltolization was first applied to a straight fatty oil (fish oil or any other material containing unsaturated molecules) and continued until the material had reached a viscosity of 70 Engler degrees. At this point 10 per cent pure mineral oil is added and voltolization continued until the combined oil has attained a viscosity of 90 Engler degrees at 50 degrees C. This procedure is then continuously repeated until 90 per cent mineral oil has been worked in and is voltolized to 90 degrees Engler at 50 degrees C. It will be noticed that by using this process the voltolization can be raised to 90 Englergrades, whereas using either straight fatty oils or straight mineral oils the maximum of thickening is only 70 Englergrades. Above this point a gelatinizing or coagulation occurs. Rhenania-Ossag have reported time savings of 50 per cent for this process over the old Hemptinne process.

Voltol-Extract as a Base for Compounding Oils

However, it has been the practice in the last years to prepare only a base of voltolized oils, which is added to straight mineral oils in percentages ranging from 1 per cent to 25 per cent, according to the desired characteristics of the end products. This base consists either of voltolized mineral oil, described here as the Ossag process, or of a mixture of fatty oil and mineral oil, described here as the Rhenania-Ossag process. It has been found that the preparation of a basic voltol material and its addition to mineral oils is more economical than any of the other processes.

Action of the Silent Electrical Discharge Upon Ethylene Hydrocarbons

The action of the silent electric discharge on ethylenic hydrocarbons is closely similar to that of high temperature and pressure. The character of the final products depends largely on conditions, prolongation of the action causing increase in the quantity of highly polymerized, non-volatile substances. Increase in electric tension does not influence the process to the same degree, whereas the structure of the original hydrocarbon greatly affects the rate of reaction.

Action of Silent Discharge Upon Tars and Coal-Tar Oils

The electric glow discharge changes the properties of tars and oils derived from coal tars somewhat in the neighborhood of petroleum mineral oils. Crude low-temperature tar loses under the action of the silent electric discharge some of its unsaturated compounds. The finished product has a smaller tendency to resinification, a higher flash point and a lighter color.

Influence of Electric Glow Discharge Upon Fatty Oils

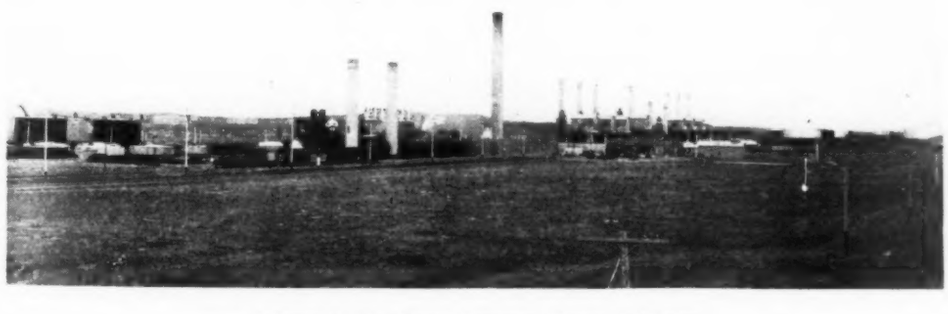
When fatty oils are submitted to the action of the silent electric discharge in the presence of hydrogen at low pressure, polymerized products are formed of such high viscosity that further treatment is impossible.

Yield of Stearic Acid From Oleic Acid by Silent Electric Discharge

Under the action of the electric glow discharge oleic acid yields about 16 per cent of stearic acid independently of whether in the presence of hydrogen, nitrogen, carbon dioxide or common air. The hydrogen necessary for the reaction comes from the oleic acid molecules itself, and the highly unsaturated compounds produced simultaneously condense to form polymerized molecules. This opinion is supported by the determination and comparison of the iodine values and the molecular weights. When oleic acid was voltolized in the presence of nitrogen the mean molecular weight increased and the iodine number decreased. Eichwald is reported to have obtained molecular weights up to 6000 from the benzol solution of voltolized oleic acid.

Equipment Used for Electric Glow Discharge in Oils

There are several plants in Europe commercializing the Voltol process. Some of them have only a limited capacity, others are more elaborate. In the German Electron Oil Works at Dresden in Saxonia is a closed horizontal cylindrical still used of only 900 cu. ft. capacity. The stills in other plants are considerably larger. A shaft going through the still in horizontal form is attached to a set of gears, which drives the tubular still around at a very low speed. The shaft carries four electrodes and at the circumference of each electrode is a scoop for catching the oil, which, when the shaft rotates, trickles down between the electrode-plates, which are securely insulated from each other. The plates used in the Dresden plant are alternate aluminum and pressed insulating paper, having an active surface of almost 6000 sq. ft. The current is transmitted into the tube through insulated conductors, which are set in ground joints. The connection between the aluminum plates and the electrical conductors is made by braided wires and two rails placed along the electrodes. Wooden boards are attached to the plates made from pressed insulating paper, giving support to the smaller aluminum plates. Care has been taken to separate the edges of the plates in order to avoid sparking. The fundamental equipment for



Refinery of The Texas Company, Casper, Wyoming.

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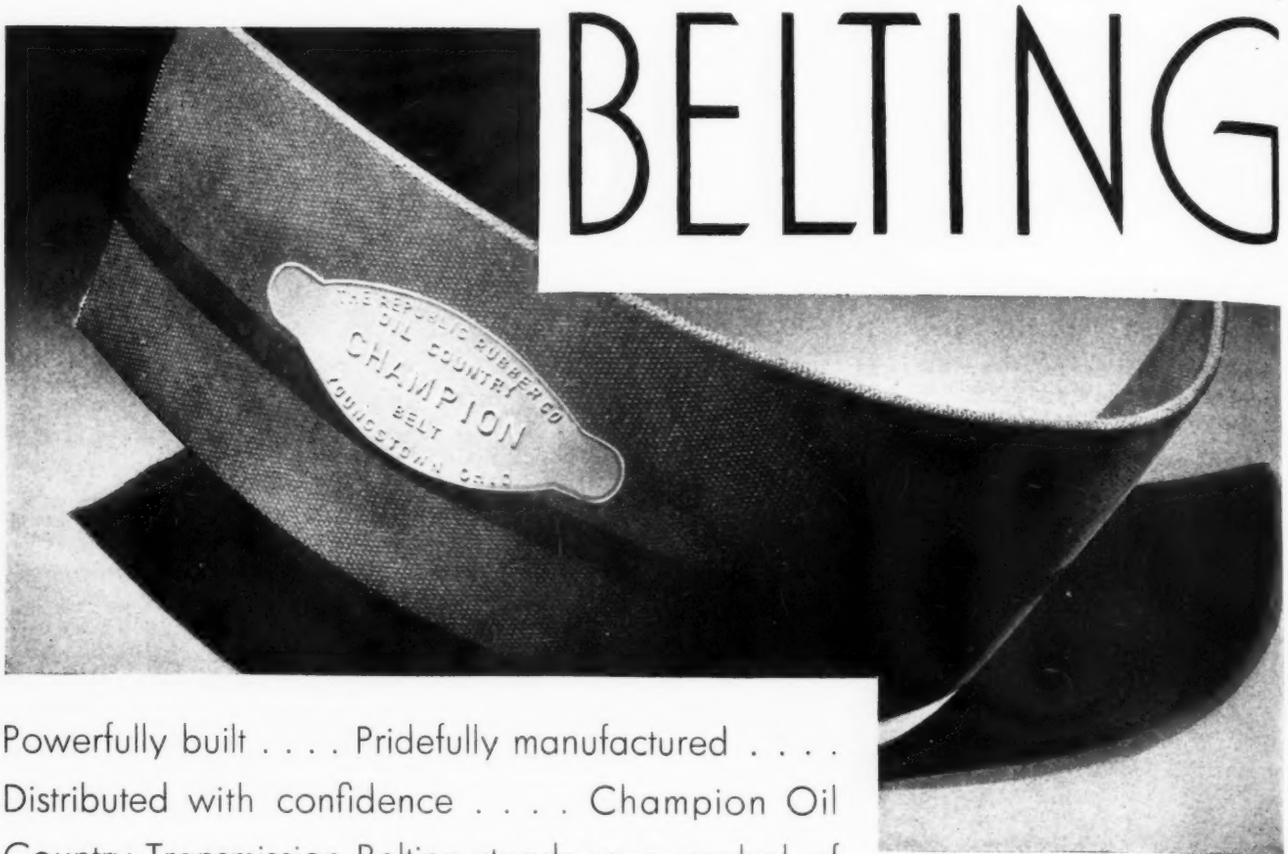

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voltolizing fatty oils and mineral oils is described clearly in the German Patent No. 234,543.

The Procedure of Voltolizing Oils

A high-tension dynamo of 300 k. v. a. is required to produce the silent electric discharge, a single-phase current of 4300 to 4600 volts, and a frequency of 500 is necessary to give 1000 discharges per second. The pressure must be maintained at 0.9 atmosphere, otherwise no glow discharge will occur. The intensity of the current is usually 19-20 amperes. With a rise of the pressure in the still the current intensity will decrease; therefore, it is necessary to connect a small pump in order to maintain a pressure of 0.9 atmosphere. A small boiler is desirable for the purpose of heating the oil to around 150-170 degrees Fahrenheit before charging into the reaction chamber. After the oil has just covered the lower electrode the drum is tightly closed and, after a pressure of 60 cm. mercury inside of the reaction chamber has been reached, hydrogen under a pressure of 56 cm. mercury is charged into the chamber, replacing the air and the oxygen. The pressure inside the chamber then is regulated to 65 cm. mercury and kept at that level. After the power has been switched on a direct-coupled speed reducer rotates shaft and electrodes inside the reaction chamber at a rate of one revolution per minute. Then the current is switched on and the interrupters regulate the current at a rate of 500 cycles. Soon the glow discharge is active and the chamber is filled with a violet light. The oil then runs continuously out of the scoops, trickles over the electrode plates and undergoes a kind of vibration, thereby changing its chemical structure. During this treatment the oils undergo no change in regard to acidity, asphalt content, cold test, flash point and fire point increase during the voltolizing.

Chemical Dissociation the Cause of Increase in Viscosity

By determining certain chemical and physical properties of voltolized oils it is shown that these oils contain polymerized molecules in the colloidal form. Research into the characteristics of treated whale and fish oils in comparison with the untreated oils indicates that the ions and electrons on the surface of the oil in the treating drum very likely split the double bonds of the unsaturated fatty acids, thereby permitting the formation of polymerized compounds, which are held in suspension in the remainder of the oil.

Influence of the Silent Discharge Upon the Viscosity-Temperature Curve

Mixtures of mineral oil and voltolized oils possess a very flat viscosity curve. This is especially useful for the compounding of airplane motor oils, tractor oils and regular internal combustion engine lubrication. Oils which are improved by compounding with voltolized oils have another advantage—that is, the same oil which will give satisfactory lubrication in hot weather will be liquid enough to serve also in cold weather. Since the modern high-compression motor needs a lubricating oil not only of higher viscosity but also of increased oiliness, the treatment of motor oils by the silent electrical discharge opens a road to possibilities.

The Manufacture of Transformer Oil by the Electric Glow Discharge

A high-grade transformer oil has been made for a number of years in one of the European plants using the Voltol process. The starting material was Russian as well as New Jersey water-white kerosene of 43-46 gravity. The closed horizontal processing drum had a capacity of 900 cu. ft., rotated around a central axle, which carried four electrodes to which scoops had been attached. These latter lift the oil from the lower part of the drum and pour it through the spaces between the electrodes, which are insulated from each other. The alternating current used is of 19-23 amperes and 4500-volt; the temperature is kept at 140-170 F., the pressure is maintained at 60 cm. mercury and the air is displaced by hydrogen. A certain amount of hydrogenation takes place. The resulting product has increased considerably in viscosity, but the liquidity of the oil at room temperature and below zero has not suffered.

Voltolized Industrial Oils Reduce Cost of Maintenance and Increase Power Output

The Ossag has reported from time to time regarding the actual performance of lubricating oils compounded with voltolized oils. Tests have been made on electric generators, steam engines, turbines, Diesel engines and other power-producing engines. Important power savings have been reported; savings on lubricating oil have also been reported; savings on the cost of lubrication have been reported, and reducing of frictional heat has been reported from 25 to 55 per cent.

Voltolized Steam Cylinder Oils

It is well known that steam cylinder oils have to be compounded with fatty oils when the steam is wet or saturated. Straight mineral cylinder oil will not adhere to the cylinder walls in the presence of moisture. Tallow and lard oil are the two substances most widely used for this purpose on account of their ability to form quickly emulsions. Both materials have the disadvantage of containing fatty acids to a greater or smaller extent and to get rancid and become oxidized easily. If a voltolized oil is used in the place of a straight fatty oil, then the compounded steam cylinder oil has all the advantages of the fatty oils but not the disadvantages. Voltolized steam cylinder oils form stable emulsions with water and protect the lubricant against vaporization and decomposition.

Voltolized Oils as a Base for Semi-Solid Lubricating Greases

The solidification of mineral oils by the addition of oxygen is known and such solidified oils are already made as a side line. Likewise, it is possible to produce solidified oils without the addition of metallic soap by using voltolized or polymerized oils as a thickener for light-bodied mineral oils. Lubricating compounds having the consistency of No. 0 to No. 3 have been made successfully. However, the application of such solidified oils is limited to such machinery where water is not present. Solidified oils made by using polymerized fatty oils are able to take up a certain percentage of water. This characteristic makes such lubricants desirable for use in the textile industry.

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Problems *in* Drilling Practices *in* VENEZUELAN FIELDS . . .

By HAROLD B. RICHARDSON

A ROWBOAT circled erratically on the smooth expanse of Lake Maracaibo, Venezuela. In response to a wig-wagged order from the shore the boat came to a stop and a stake consisting of a joint of one-inch pipe was placed upright in the bottom of the lake. However futile this procedure may have appeared to a casual observer, it really has some significance, as it marks the first definite step in starting a well—that of staking a location in this outpost of American capital devoted to the production of oil in Venezuela.

Presently a launch towing a pile driver appears on the scene, fore and aft anchors are dropped and the work of driving the foundation piling begins. In a country so bounteously forested the importation of pine and fir for piling may seem at first sight uneconomic. The use of native timber for piling has been discontinued because of the havoc played by the "Teredo," a species of marine-boring animal, which, by honeycombing the piling, renders it unsafe in a comparatively short time. Considerable research and experiment has culminated in the adoption of a special creosoting process that successfully eliminates this hazard.

After the driving of the piling has been completed the rigbuilders come on the job. The piling is cut off and capped. A sturdy foundation is then constructed upon which one of the modern drilling derricks is erected. The casing-rack and mud box foundation form a part of this unit. A separate foundation and connecting "walk" are driven for the boilers.

A small barge manned by natives soon becomes busily engaged in laying the mud and fuel lines from the shore of the lake. The pipe is screwed together in the usual manner and the barge pushed ahead one joint, permitting the lines to settle to the lake bottom. Risers are installed when the location is reached.

Derrick barges equipped with a gasoline hoist transport the rigs from location to location, and the speed with which these operations are effected compare very favorably with what can be done on land.

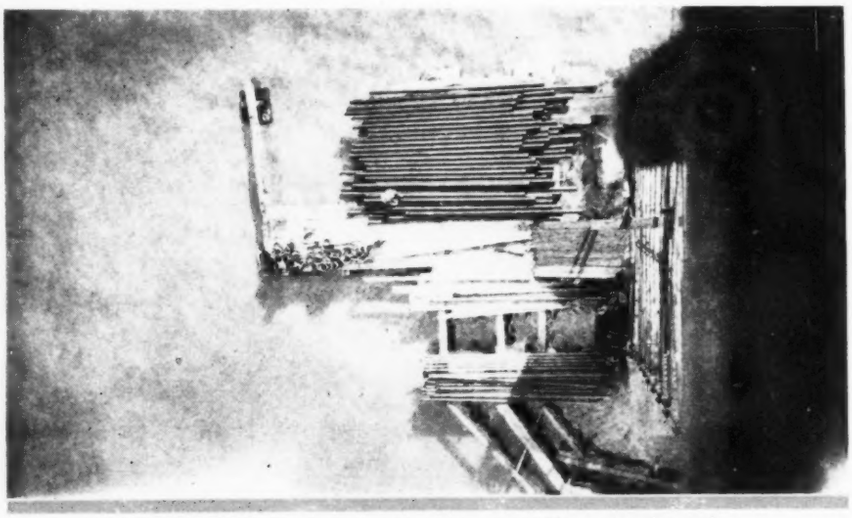
A blow-out, La Rosa-Ambrosa Field, Venezuela.

In the Maracaibo Lake Basin the character of the formations are such that comparatively easy drilling is encountered from top to bottom of the well; as a consequence the drilling equipment is much lighter than that used at present in the Mid-Continent fields. Draw-works having a 6-inch hoisting drum shaft and 6¾-inch by 12-inch by 14-inch slush pumps are in general use. Each rig is equipped usually with three 65-H.P. boilers.

It is the general custom to spud in with a 24-inch fishtail, and 50 feet is drilled for a 20-inch conductor. This hole is "made with the lake." In other words, the pump suction is placed in the lake as drilling commences. Once the conductor is set, mud is received through the line already mentioned and permitted to flow into a wooden mud box that is moved with the rig. Circulation is maintained by means of a flow-nipple in the top of the conductor leading off into a wooden sluice or mud ditch that more or less encircles the derrick foundation to permit sufficient space and time for settling. Hole is then made through the conductor down to about 350 feet, at which point the surface pipe is set and cemented. The amount of cement used varies from 60 to 130 sacks. This enormous variation is made necessary by the occurrence of a dangerous and troublesome surface gas which fortunately is confined to the Ambrosia-La Rosa or southern portion of the fields. The methods employed in cementing are very efficient. A slush pump is mounted on either end of a barge large enough to permit the stacking of 500 sacks around the hopper, power being provided by means of a hose connected by a union to the steam line of the rig. A cement ring and one plug are used. After cementing the surface pipe it is allowed to stand 72 hours before drilling is resumed. While waiting for the cement to set, a 12½-inch master gate and blow-out preventer are assembled on the casing, whereupon drilling is resumed and the hole completed down to the top of the sand. Coring is the rule rather than the exception, as a barren sand immediately overlies the productive zone. The water-string,

usually 8⅝-inch casing, is often swung and cemented with 350 sacks of cement, as top water presents an intricate problem, a lengthy discussion of which is outside the scope of this article.

The productive zones vary in depth from 200 to 500 feet. One of the American companies has standardized on a completion procedure wherein a 6-inch liner of perforated pipe is utilized, this being sealed to the inside of the 8⅝-inch casing. Wells are usually completed with a flow-string of 3-inch tubing to which a christmas tree is attached, and are brought in with a minimum of trouble. Sometimes the mere removal of the mud column by establishing circulation with water is sufficient. Again, a few hours' swabbing may be necessary. Pick-up stations, supported on piling, receive the output of the wells, and pump the oil to the tank farms located on land. From the 80,000-barrel tanks there, the oil is run through discharge lines laid along the wharf to the tankers.



View from top of a derrick looking down on outside to the pipe rack.

The Venezuelan Government has steadfastly refused permission to the oil companies to dredge the bottle neck and Bar at historic San Carlos, and as a consequence the oil companies have been compelled to construct a special flotilla of tankers to meet these shallow draft requirements. These tankers, which vary in capacity from 12,000 to 18,000 barrels, after receiving the oil, proceed to the bar to await the favorable tide. The destination of the tankers is usually Aruba or Paraguana. The latter takes its name from the wind-swept peninsula of Paraguana, where considerable storage has been erected and transshipment is made to the huge tankers that ply between this point and American refining centers.

It is the desire of the Venezuelan Government that the oil companies maintain at its highest possible point the ratio between native and foreign labor. This request, coupled with the natural economic advantages of hiring a Venezuelan in Venezuela, has had a tendency to minimize the number of Americans employed. In the operations described, pile-driving, rigbuilding and drilling, only five Americans are necessary. Three of these are due to the demands of running tour. In a word, all the actual labor is performed by natives, the part played by the foreigner being mainly that of supervision. A considerable percentage of the native labor is recruited several hundred miles from the scene of operations. These individuals come from the island of Margarita, where, prior to an opportunity to work for American companies, they had eked out a rather uncertain existence by fishing and pearl diving. The average wage scale is Bolivares 10. Much is said of the inefficiency of native labor. In fairness it should be stated that considering the complete illiteracy that characterizes this unfortunate class of people, plus the enormous disease and mortality rates to which they are subjected by the total lack of any attempt at sanitation, they are but the victims of circumstance and the natural

Oil field camp at Cabimas, Venezuela.

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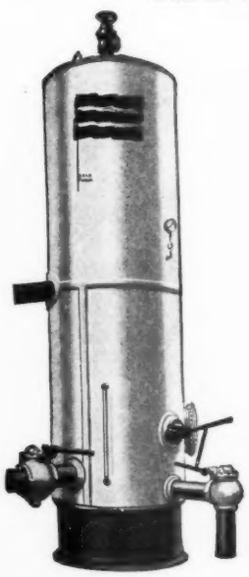

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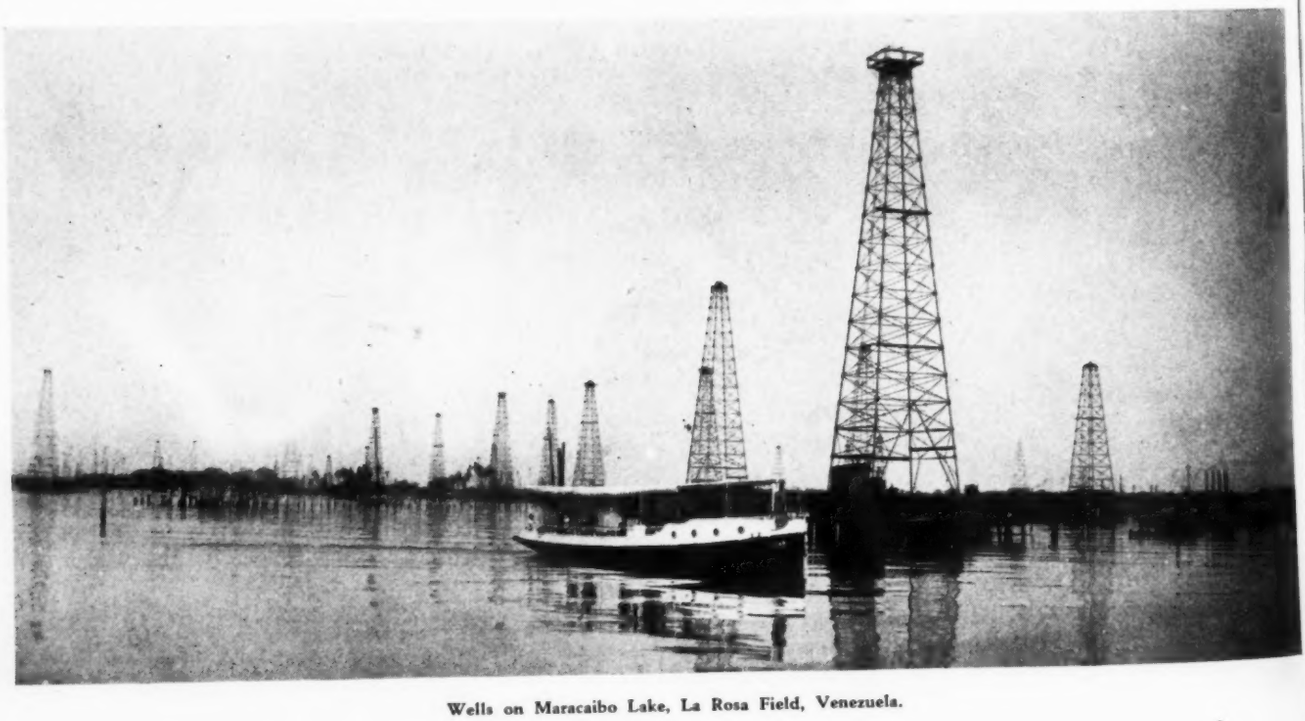
result of the environment they are forced to support.

The Venezuelan subsoil is the exclusive property of the Federal Government, participating to the extent of 10 per cent in the total production. This steady influx to the country's coffers, results in Venezuela enjoying a very marked prosperity, evidence of which is her freedom from external debt and the ever-increasing impulse that is being given to the construction of permanent paved highways. In fact, Venezuela occupies first place among South American republics for paved roads in proportion to population. Exchange is steady at Bolivares 5.20 to the dollar, and the country gives every evidence of entering upon a period of prosperity made possible by 20 consecutive years of stable Government unmarred by revolutionary disturbances.

In closing, mention should be made of the great length the various oil companies have gone to the provisioning and providing the American employes with those comforts that are tending to become necessities in the steadily advancing standards of American living. There are hospitals for the sick and injured, provided with the most modern equipment and directed by competent American physicians. Recreation facilities consist of swimming pools and tennis courts. Baseball teams have been organized, and a keen competition for the pennant exists. Foodstuffs are, with few exceptions, imported from the United States.

Here a well is just starting to blow out, La Rosa Field.



Wells on Maracaibo Lake, La Rosa Field, Venezuela.

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Unusual Ditching Problems

By HOUSTON

THE Missouri Valley Pipe Line Co. has an enviable record of construction for the last year. An astonishing amount of line has been planned, contracted and either put into operation or is now under construction. This story will not attempt a discussion of all the work on this line, but will limit itself to that particular section being built by the Truman-Smith Construction Co. beginning at a point near Ogden, Iowa, and extending to a point 11 miles west of Mason City, in Cerro Gordo County, Iowa. This part of the line is 20-inch diameter pipe sleeve coupled and approximately 87½ miles long. Sixty-pound, welded, high carbon steel pipe with $\frac{3}{32}$-inch side walls is being used. The protective coating is applied cold over the factory priming.

The line is laid through Iowa's famous corn belt. In general, the country is rolling farm land. The soil is mostly black gumbo and, after the dry season of this last year, one could expect ideal ditching conditions. There is little wooded land to cross, one river and a lake.

But these appearances are deceiving. This entire section of Iowa has been reclaimed from marshes and even old lakes. Tiles line the subsoil of nearly every farm. Some of them run water the year 'round—even after such a dry season as last year. Although the contract specifies a 30-inch cover on the ditch, the average has been much greater on account of the necessity of going beneath this drainage system, which lies from two to six feet below the surface. The tiles range from 4 inches to 36 inches in diameter and are replaced by county men who are paid by the pipe line company. Where the ground dips and the tiles are found still flowing, the soil seems very loose and often sloughs off in great sections. Generally this caving soil is only the part broken loose by the weight of the ditcher, but a drained lake bed was encountered that presented quite a formidable problem. Here it was necessary to clear a tile main that made necessary a cover of nine feet over the pipe. The soil was so lacking in cohesion that the walls of the ditch caved as fast as the ditcher passed through. To clean such a ditch by hand and dig it down to the required depth by hand was made more difficult by a water-bearing sand at the depth of some seven feet and a cold wave that swept across the prairie with a thermometer reading of about five degrees above. The situation was solved by using a pull shovel to dig the ditch and a crane with a half-yard clamshell bucket to clean it. Hand work was done only to clean the sides and the high spots on the bottom. Pipe was laid a joint at a time and followed as closely as possible behind the clamshell. In this manner this short stretch of one-quarter of a mile was laid in two and a half days.

As winter progresses, ice becomes an ever-increasing handicap. It covers the pipe in foggy days and must be removed before the couplings and paint can be applied. Torches are used to break the skin of the coating and the pipe is then thoroughly cleaned of moisture with burlap sacks.

The line crosses several gulches that approach the proportions of canyons. The smallest of these will be bridged, but some are so large that it is necessary to ditch them by hand. The soil on these hillsides is usually a sort of hard sand and, when frosted down to some depth, is extremely hard and must be picked out slowly and laboriously.

Above—Casing a railroad crossing. Below—Lowering pipe in ditch.

[1]Truman-Smith Construction Co.

On Missouri Valley Line

JOHNSON[1]

Construction Methods

Right-of-way: The usual right-of-way gang is employed to clear brush, cut trees, etc. In addition, the company uses two pull shovels to cut off rough places on the line, preparing the way for the ditchers and eliminating a lot of overbends and hand work. The pull shovels also make the deep cuts on each side of railroad crossings. These railroad crossings are all cased in 24-inch steel line pipe. The casing is welded and snaked through the ditch and under the tunneled roadbed. The welded length of 20-inch pipe is pulled through the casing, 3-inch pipe vents welded into the casing, the crossing cleaned of water and cemented in.

Ditching and grading: With the contract calling for only a 30-inch minimum cover on a 30-inch ditch, small machines started the job. It was soon found that larger machines were necessary in order to take care of the deep ditches around drainage tile mains. Two larger machines were shipped in and have eliminated a great deal of hand ditching by being able to grade the ditch down to the required depth.

Cleaning and painting: Most of the right-of-way leads through black land corn fields. The pipe strung on this ground is cleaned of the mud (often frozen) before painting. It is skidded on 4x6's and completely painted on all sides. The paint is poured on cold and brushed out evenly by a gang which uses long-handled brushes. Little thinning material is allowed, so that a good, heavy coating is obtained. Couplings are daubed with uncut paint.

Welding: Although the line is coupled, there is some welding to be done. All overbends and railroad crossings are welded. The Truman-Smith company has not broken one of its welds to the date of this writing. The pipe is first tacked in five or six places and then welded slowly.

Right—Stabbing a joint. Below—Setting a main line 20-inch gate.

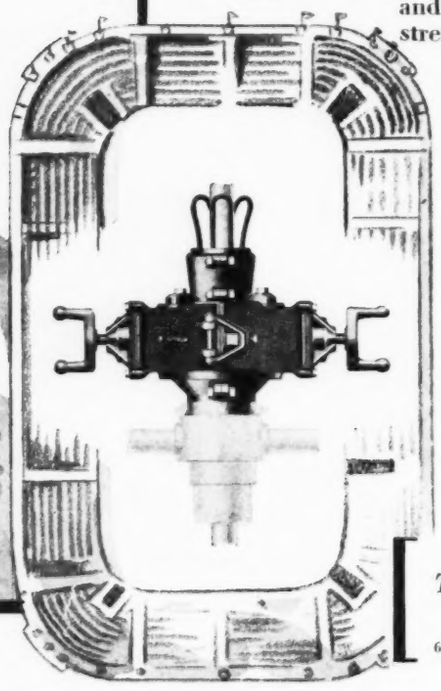
CONTROL

MEANS AS MUCH TO A FLOWING WELL AS IT DOES TO THE PIGSKIN PASSER

Obtain it with the GUIBERSON Control Head Packer

Nothing is more dangerous than a wild pass in a football game. It stands a good chance of being intercepted by the enemy, who may get away for a touchdown. If it escapes interception, it runs the ends needlessly and loses a down and yardage. If it occurs often, it dissipates the strength of the team and breaks the fighting morale. A flowing well, running haphazardly through the casing, can be described almost in the same terms.

The Guiberson Control Head Packer confines the oil to the tubing, prolonging the flow by conserving the gas pressure and making it lift the oil in a steady, even stream -- with maximum production. The gravity of the oil is preserved by maintaining the surface pressure in the well. Ample passage for oil and gas allows the Guiberson Control Head Packer to run in against the heaviest flows.



TO PACK FLOWING WELLS:

The Guiberson Tubing Oil Saver, set on top of the casing, confines the flow while the Control Head Packer is being run. Its rubbers permit passage of tubing collars and it can be opened wide to admit Packer or Tubing Catcher. Recommended for use with the Control Head Packer.

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The GUIBERSON CORPORATION
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California Branch: 1506 Santa Fe Ave., Los Angeles
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GUIBERSON

BETTER BE SAFE THAN SORRY

When writing THE GUIBERSON CORPORATION, *please mention The Petroleum Engineer*

A carbonizing flame and number one welding rods are used. The finished weld is usually about ⅞-inch wide and just a little higher than the pipe.

Bending: All bends are made hot. The piece to be reshaped is angled to another joint and a steel wedge

Right—Ditcher with cab for operator. Below—Looking down a 7-foot trench.

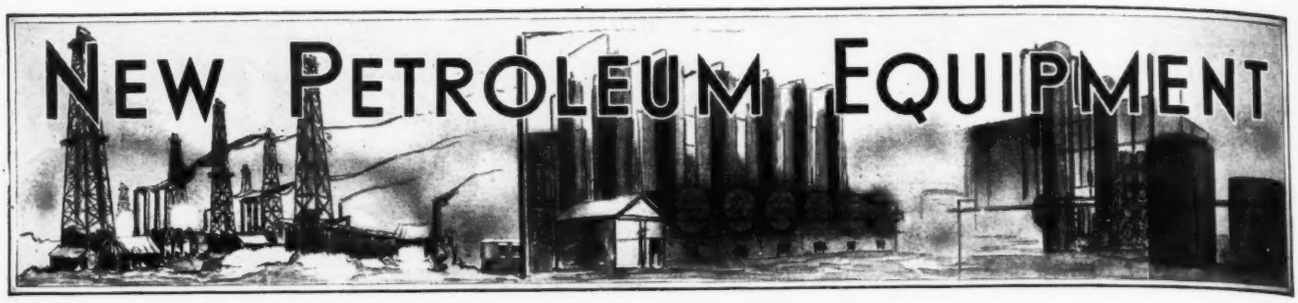
placed between them just below the intended bend. A steel shield is blocked against the pipe at the point of the bend and, with it as a backing, the flame is wrapped around the pipe. The two joints have been previously tied at the converging ends with a steel cable wrapped in a figure 8 about the two ends. Tension is taken at the other end through a block and tackle. The end of the cable on this rigging is wound around a piece of heavy 6-inch pipe inserted in the cold or stiff joint. The 6-inch pipe is turned with lay tongs so that any amount of pull can be exerted upon the hot joint. A 110-foot compressor supplies plenty of air to the torches, which put out a very large and hot flame. Two of these torches will cover the 8-foot shield with flame.

Coupling: The rolling gang rolls the pipe onto skids over the ditch so that it is lined up ready for the connection gang. Follow rings and rubbers are placed on the ends of the joints and the correct number of bolts are piled at about the place of the coupling. The laying crew tractor picks up the joint to about two feet. The "stabber" at the far end of the pipe guides it as the tractor moves back toward the coupling. The "center-ring" man centers the pipe so that it will strike the center ring of the coupling true. Two men place skids under the free end. The "cat swamper" unhooks the line as the "two-bolters" start their ratchet-wrenches and a man places another center ring on the end of the newly laid joint ready for another coupling. Wrenchers, working in pairs, finish up the coupling and paint daubers follow them to completely coat the coupling and bolts as well as any unprotected surface of the pipe that may have been burned off by the bending crew.

Lowering in: Lowering in is done by five tractors equipped with side booms. Four machines, used at first, proved insufficient on account of the unexpected depth of the ditch. It was found that five would make the slope more gradual and speed up operations. The foreman stands on the spoil bank at about the center of the line-up and guides with arms stretched out to each side the lowering of the line and the descending curve. As soon as a tractor has its joint on the bottom of the ditch the swamper unhooks the line and the machine travels up to the front, where it picks up a new joint. A man is there to pull the skids and the tractor is ready to start easing down its part of the line. A man works at each end of this crew, lining up the pipe in the ditch with a long bar.

Backfilling: Most of the backfilling is done with a regular backfilling machine. Some very muddy places were filled with a clamshell and the final or finishing work will probably have to be done with a backhoe, as the spoil bank frosts very solidly and often cannot be touched with a backfiller.

Testing: Gates are placed at intervals of about ten miles. Before final backfilling, each section must stand the soap-suds test. Air pressure is built up on the line to about 125 pounds and the couplings, which have been left bare for this purpose, are washed with soap and water to detect any leaks. After this test the line is completely filled. When the contract is completed, pressure will be built up on it and all gates closed. It will be required to stand for 24 hours without drop in pressure.



Ideco-Boykin Pumping Counterbalance Weight

THE Ideco-Boykin counterbalance weight (Yount Patent), a new product manufactured by the International Derrick & Equipment Company at its Boykin plant, Beaumont, Texas, is designed to provide a simple and effective way of balancing the weight of the rods and tubing on pumping wells. It is especially applicable to deep well pumping and permits a smooth and even stroke, the makers state.

The weight is designed for use with standard 12-inch and 14-inch walking beams. It is constructed in a variety of weights. Additional weight elements, as shown in the illustration, may be added to give any weight desired. These are made so that they can be handled easily.

The counterbalance weight is provided with rollers which serve to facilitate the moving of the weight to the exact position along the beam for the most efficient operation. The rollers make it a simple matter for one man to move the weight along the beam. Two set screws provide a means of fastening the counterweight at any desired position. The screws are locked in place after the weight has been securely fastened to the beam, by means of a safety locking nut, which prevents the screws from loosening due to vibration and other causes.

When pulling the rods or tubing, the weight can be moved to a position immediately over the saddle and anchored, so that the walking beam may be swung out to the line of operation.

Fomon Foam Units on Oil Field Fire Truck

C. A. McNAMARA, purchasing agent; S. C. Phillips, superintendent of transportation; H. W. Bogges, safety engineer, Sinclair Oil & Gas Company, and W. L. Walker of the American Fomon Equipment Co., of Tulsa, Okla., have designed and had built at the Oklahoma Auto Body Works in Tulsa what is considered an excellent and compact fire and first-aid field unit. This unit was built on a standard 1½-ton Sinclair Oil & Gas Company transportation truck and is equipped with a Barton centrifugal pump having a water capacity of 400 gallons per minute at 100 pounds pressure and which will pump water mixed with sand or mud without damage to the pump.

The hose equipment consists of regular fire department hose to be used for large streams of water in combating ordinary fires or for delivering foam to oil fires. Small hose equipment is used for grass or prairie fires.

The two large Fomon foam generators have a capacity of 1000 gallons of foam each per minute and one of 300 gallons capacity. The truck carries 1000 pounds of foam chemicals, besides extinguishers for electrical, oil and other fires.

First-aid equipment consists of stretchers, gas masks, emergency splints and a complete first-aid supply kit, neatly packed in metal cupboards mounted on the side of the body.

The equipment Halliburton uses is very efficient—the process so far advanced that no other even approaches it; and yet our greatest asset is not equipment, not methods, but a treasure that neither money nor ingenuity can buy—EXPERIENCE. Each of the 40,000 wells that we have cemented was, of course, a little different from its predecessor. Each contributes its share to the vast storehouse of cementing knowledge, and so helps to assure you of a safe, efficient and dependable job.

HALLIBURTON
OIL WELL CEMENTING CO.
Duncan, Oklahoma

Because no commercial equipment is strong enough, Halliburton strengthens, reinforces every part of its cementing apparatus.

Would you, as a reader of The Petroleum Engineer, like to receive copies of THE CEMENTER as issued? Each number contains interesting information about cementing and drilling fluids. There is no cost or obligation—simply sign your name below and mail to Halliburton Oil Well Cementing Co., Duncan, Okla.

Name..... **Address**.....

When writing HALLIBURTON OIL WELL CEMENTING CO., *please mention The Petroleum Engineer*

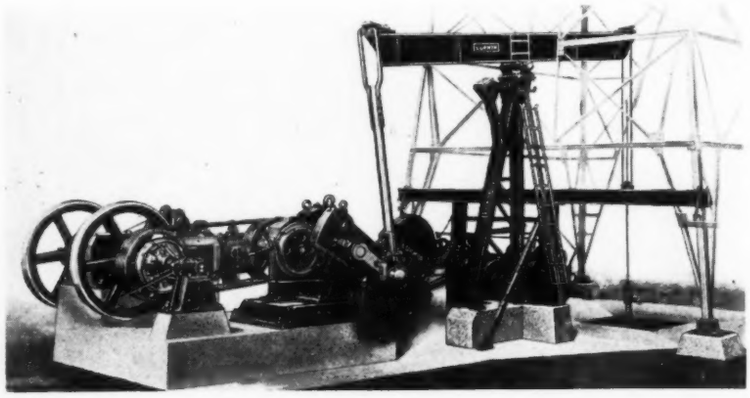
Lufkin Introduces New Type of Unit for Gas Engine Drive

DESIGNED for use with any type of single-cylinder engine, the new Lufkin slide base unit is meeting with immediate acceptance, the manufacturer states.

The new unit is mounted on a "slide base," which eliminates the use of a tightener ordinarily necessary with single-cylinder engine drives. The unit is designed to set 10 inches to the rear of its usual center (10 inches behind plumb line of pitman), which results in a slight advantage in power, due to less angularity of pitman when rods are coming out of the hole.

This type of drive affords an outlet for the salvage of so many single-cylinder engines which were in general use with standard rigs before the advent of the Lufkin reduction gear for pumping, pulling and drilling.

The several installations of the new Lufkin slide base unit have been inspected by engineers of some of the major operators and they have commented very favorably upon its design, according to the manufacturers.



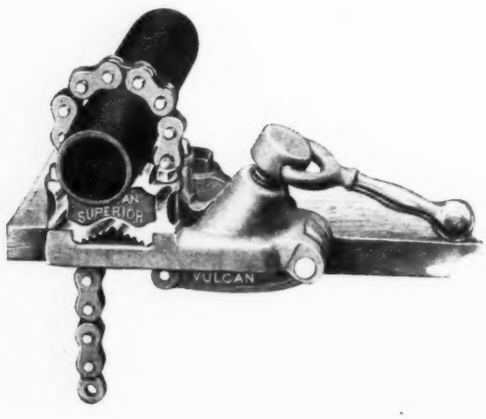
A request addressed to the Lufkin Foundry & Machine Company at Lufkin, Texas, or its several branches, will bring full particulars concerning this new Lufkin unit.

Williams' Chain Pipe Vise

THE new "Vulcan Superior" vise, placed upon the market by J. H. Williams & Co., Buffalo, N. Y., offers two outstanding advantages. First, overhead adjustment — the handle is on top where it is easy to operate. Second, reversible jaws for longer life — when the teeth first in use wear simply unscrew the bolts and turn the jaws over.

In addition, the makers state, each "Vulcan Superior" is of greater capacity, taking pipe one-half inch larger.

It is made of tough wrought steel, with no castings, with drop-forged base, jaws, handle and chain-arm. The chains are unbreakable, compact, rapid in action, positive in grip.



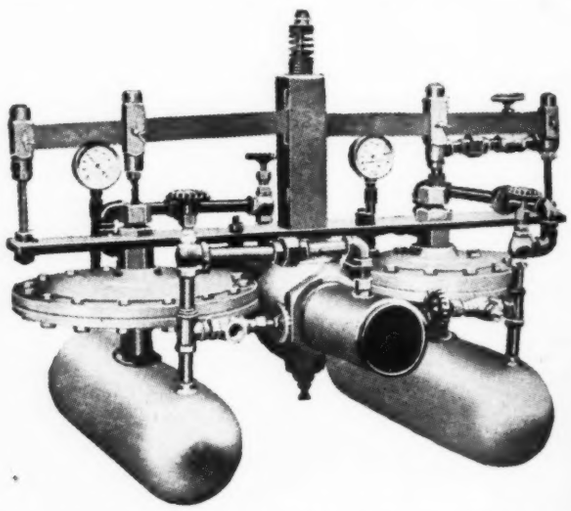
This vise is furnished in two styles—chrome-plated and standard finished with orange panel in jaws. It is also furnished in two sizes for one-eighth to four and one-half inch pipe.

Literature will be supplied by J. H. Williams & Co., on request.

Badgett Has Automatic Fire Control

BADGETT STEAM LUBRICATOR COMPANY, Chickasha, Oklahoma, has announced a new Automatic Fire Control, which they state is easy to install and inexpensive to operate.

The manufacturers say further that it works accurately on variation of gas pressure from 5 to 300 pounds and is easily changed for any burner pressure by merely opening a needle valve, allowing the pressure to reach the desired point. The control is operated on gas until the desired steam pressure is reached when it automatically switches over to the steam side. The steam pressure will vary very slightly on drilling rigs. The diaphragm is built to withstand 600 pounds working pressure.



The Badgett Steam Lubricator Company can supply this new Automatic Gas Fire Control in either two-inch or three-inch, single or double control. It is distributed through several large supply houses in the Mid West and through the National Supply Co., in California.

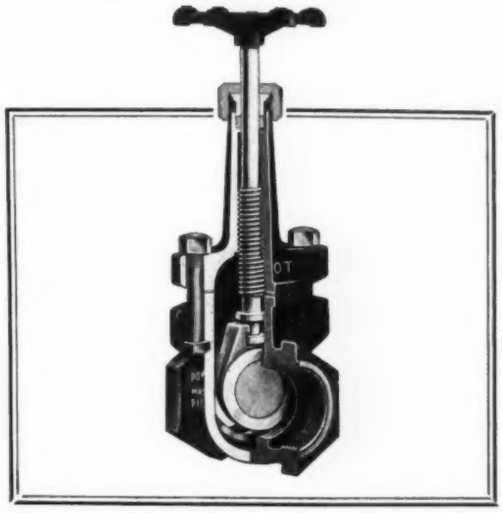
Automatic Valve Thiefhole

A NEW balanced valve thiefhole that automatically opens under 2½ to 3-ounce inside pressure and provides a large air inlet with less than one-half ounce vacuum has been introduced in the Oklahoma oil fields.

The thiefhole is circular and the opening is 14 inches in diameter with a bucket shelf inside which permits the thief operator to take his samples inside the tank proper. The lid weighs 35 pounds and raises up under sufficient pressure. The air inlet operates with a valve and counter weight which require virtually no pressure to open. This same valve, however, when under inside pressure, is pressed firmly against the inlet opening, making a tight seal. The mechanism is without springs or other working parts.

It is a product of the Columbian Steel Tank Company of Kansas City, Mo., and is available from distributors of this organization in all active oil fields.

William Powell Valves



THE Wm. Powell Company of Cincinnati, Ohio, has introduced several new products. They call particular attention to the new master pilot gate valve, a very rugged type, iron body, bronze trimmed valve.

And in addition to the standard line of bronze valves for low pressure service of 125 pounds, the company has hydraulic valves for pressures to 2,000 pounds.

Additional information will gladly be furnished by the manufacturers.

Tubing Head by Regan

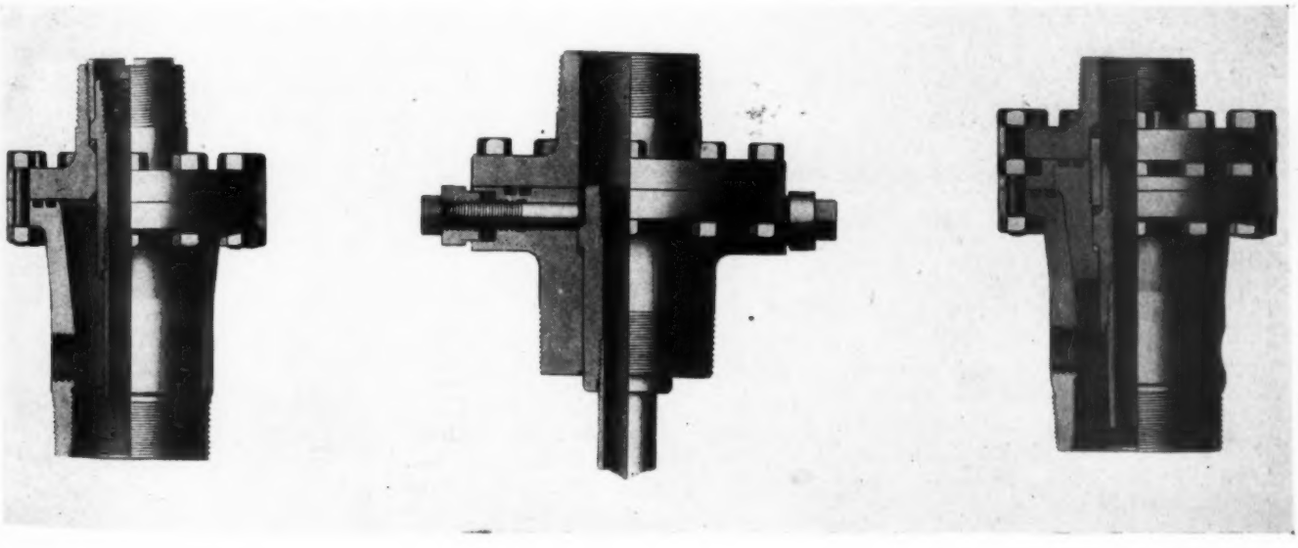
THE Regan Forge & Engineering Co. has designed and developed a new type of tubing head, which permits the moving or adjusting of tubing in a producing well, for the purpose of obtaining the most efficient gas-oil ratio.

Briefly, the construction of this device consists of a new type of flange or flanges and a coupling, in combination with their present design of tubing head body. All of the features of their tubing head equipment are retained and, in addition, a construction is provided whereby tubing-moving devices can be suitably attached.

The operation is accomplished by hydraulically plugging the tubing with an automatic plug and removing the uppermost flange with the Christmas tree. The lower flange remains intact, retains the seal and permits the installation of the Regan tubing gas controller and snubber. With the aid of the tubing gas controller, tubing can then be added or removed as conditions may require, after which the tubing is again landed, the Christmas tree attached, the automatic plug removed and the well again put on production without any harmful effects.

Several types of these adjustable tubing heads are being manufactured, to meet all of the requirements of the varying condition.

More complete details may be obtained by addressing the manufacturers at San Pedro, Calif.



Ditcher Developed for Small Ditching Work

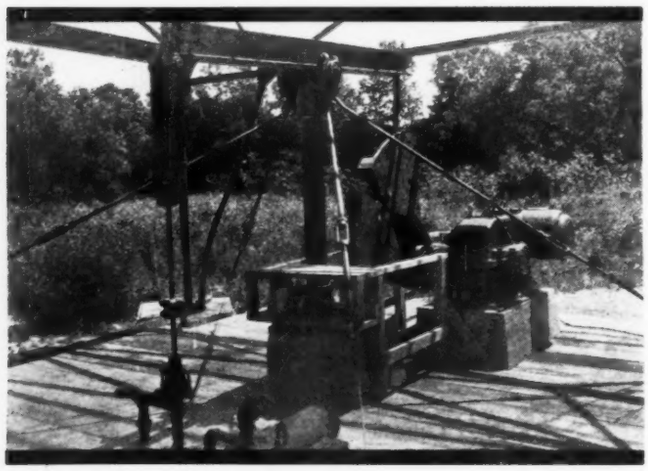
THE great amount of hand work required in digging ditches for laying small pipe brought about the development of the Little Goldigger by the C. H. & E. Division of the National Equipment Corporation, Milwaukee. This labor-saving ditcher, only waist high, not only digs a trench faster than hand work, but removes a comparatively small amount of dirt because of the narrow trench; back-filling is reduced to a minimum.

The Goldigger is designed and developed to dig a trench from three inches to six inches wide and up to 48 inches deep. Digging speeds vary from one to six feet per minute. Two speeds are available without changing sprockets and 36 speeds may be had by changing sprockets. Full multiplane traction with very low ground pressure permits operation on wet soil without miring.

Operating levers have been centralized on one side of the Goldigger for convenience of the operator in keeping his machine digging to the best advantage at all times. Rugged construction has been well balanced throughout the machine. All parts are built for severe and continuous service—gears and sprockets are of heated steel—gears are enclosed in gear cases and run in oil. A 4-cylinder, 12-horsepower engine provides the power.

Westinghouse Electric Pumping Units

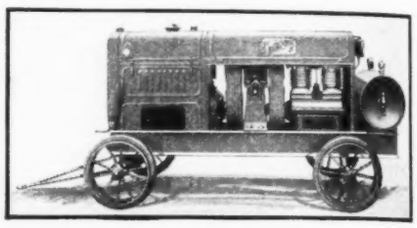
THE Westinghouse Electric & Manufacturing Company of East Pittsburgh, Pa., has designed a new line of oil well pumping units that embody the motor, control and gear in one complete, integral, weatherproof unit that may be set on a foundation any place without a special bedplate. Once the unit is set in place it remains to connect only three leads to the power supply and to join the polished rod to the hanger on the beam. These units designated as the OP-300 line are comprised of several definite ratings to meet various production requirements of 3 to 40 horsepower, 12 to 72-inch strokes, 10 to 30 strokes per minute.



The motor has been reduced to its bare elements of rotor and primary core with coils; the bearings, brackets, frame, shaft and couplings are eliminated. The primary core with coils is loosely pressed into and welded to the cylindrical motor housing which is cast integral with the top half of the case. The rotor is keyed onto an extension of the high-speed pinion shaft supported by two bearings on opposite sides of the case.

Cooling Principle in Davey Compressors

DAVEY Air Compressors, offered the trade this season by The Davey Compressor Company of Kent, Ohio, after years of private use, apply the principle of air-cooling. They deliver 142 cubic feet of air per minute.



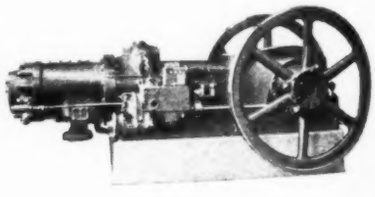
The compressor heads and manifolds are of special aluminum alloy, cast with deep fins to give greater radiating area. High temperatures generated inside the compressor head are instantly passed through the aluminum walls, preventing any possible "piling up" of heat within the compressor, according to the makers.

Due to the mechanical simplicity of this air-cooled construction, Davey Compressors weigh very light in correspondence to their capacity.

These compressors are furnished in four mountings: One each for "caterpillar" and McCormick-Deering tractors; one for trailers, and one for skids.

Reid Two-Cycle Gas Engine

A NEW engine, the 14½ by 18-inch, now augments the line of Reid Type "C" two-cycle engines, manufactured by Joseph Reid Gas Engine Co., Oil City, Pa. This engine, which is rated according to cylinder size, possesses the same features as the smaller Type "C" engines, namely: High thermal efficiency, a wide speed range, exceptionally quiet operation at high speeds, and splash lubrication. In addition, the engine incorporates high pressure lubrication to crank and crosshead pin, rotary type magneto, and a centrifugal water circulating pump mounted on camshaft box and gear driven by camshaft.



Another Striking Picture Free!

Ice-covered Derrick Scene, Enlarged to 13″ x 16½″, Given Readers as Companion Picture to That of Sensational Skelly-Amerada Burning Well . . .

AFTER the now widely familiar picture of the burning Skelly-Amerada well had appeared on the May, 1930, front cover of The Petroleum Engineer, approximately 6,000 requests for our complimentary enlargement were received. Because of the remarkable popularity of that scene, we are now making available without cost to our readers a 13 by 16½-inch enlargement of a companion picture—the equally striking view of the ice-covered derrick reproduced on the front cover of our December number (see illustration).

This impressive photograph shows, encased in tons of ice, the rig of Imperial Oil, Limited's Eagle Butte No. 1 well in the Cypress Hills of Southern Alberta, Canada. A flow of water was encountered where the producing sand was expected, and, during the cold season as the water jetted from the hole, it froze upon the derrick, building up a fantastic structure of ice.

Matchless among oil industry winter scenes, this picture, enlarged, will make a prized wall hanging. The size and quality of the reproduction will render it suitable for framing and it will, of course, contain no advertising matter.

To receive one of these beautiful reproductions with our compliments it is only necessary to fill out and mail us the coupon at the right. Since, however, we shall start printing them within the next two weeks and shall be guided as to the number by the early response to this advertisement, we shall appreciate your mailing the coupon promptly.

THE PETROLEUM ENGINEER
Exchange Bank Bldg., Tulsa, Okla.

THE PETROLEUM ENGINEER PUB. CO.
Box 1970, Tulsa Okla.

Gentlemen: Please send me the enlarged reproduction of the picture which appeared on the December front cover of The Petroleum Engineer. It is understood that this is to be sent me without cost or obligation.

Signed .....

Address .....

Company .....

Position .....

The Sotco Mud Weight Recorder

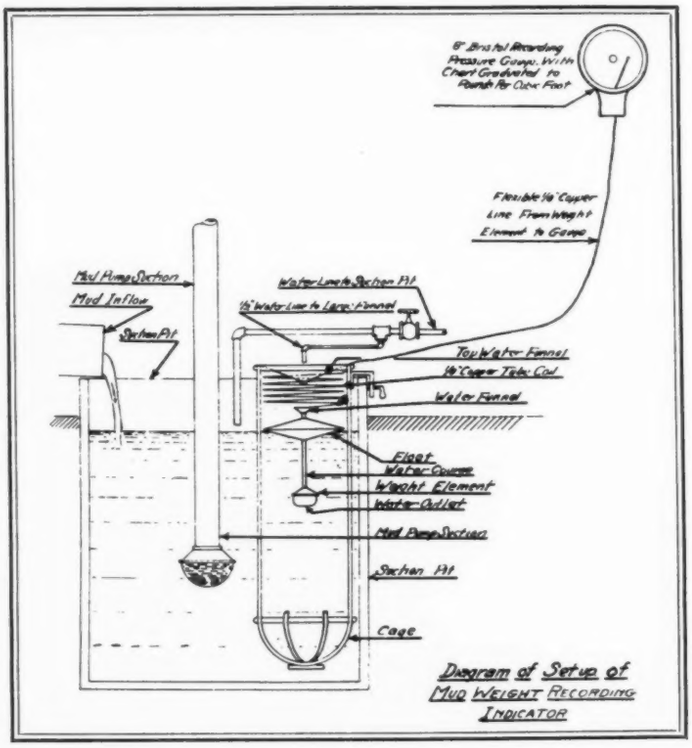


Diagram of Setup of Mud Weight Recording Indicator

SPECIALTY Oil Tool Company, Los Angeles, is marketing the Sotco mud weight recorder, which was invented to give a continuous record of the weight of the mud fluid being circulated in a drilling well or of the mud in storage and mud reclamation plants.

The instrument consists of a weight element, which is maintained at a certain constant depth or submergence by a float which is attached to the element by a brass pipe of definite length.

The brass pipe, in addition to acting as a spacer between the weight element and the float, also serves to conduct water down around the element to keep it clean and to prevent clogging and caking of the mud.

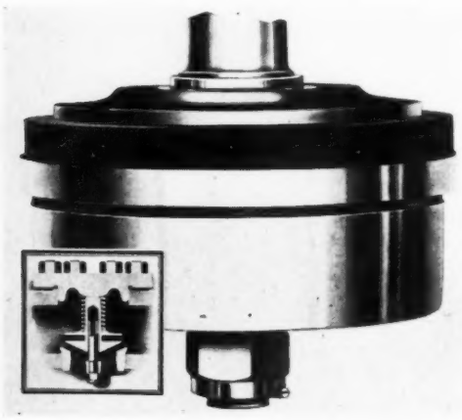
The water is introduced through the small funnel at the top of the float and circulates downward and out through the bottom around the weight element.

The weight element consists of an air chamber separated from the fluid by a specially designed rubber diaphragm. When submerged, the hydrostatic pressure exerted on this air chamber is, of course, dependent on the specific gravity of the fluid surrounding it as well as on the depth of submergence, and the air pressure on the inside of the chamber will exactly equal and balance the hydrostatic pressure on the outside.

New Mud Pump Valve

THE Gardner-Denver Company has announced a new mud pump valve that is lighter in weight, but with a great increase in strength.

This new mud pump valve has four distinct features: (1) It is a special alloy forged valve and valve seat; hardened and heat treated. (2) Valve assembly is entirely self-contained with center pin guide bolted in the seat, doing away with all extra upper and lower guides or bushings. (3) Nickel steel guide pin, hardened and ground. (4) Reduction in weight, along with increased strength.



The valve stem, made of special hardened and treated allow steel, is hollow, allowing a by-pass for the mud. Full guiding efficiency is obtained as no flutes or cuts are required. The stem is easily removed. The valve springs are also made of special alloy steel, heat treated and drawn.

The valve retainer acts as a seat for the valve spring and as a retainer, holding the valve insert in position. A square-section spring-ring lock fits in a groove in the valve holding the retainer in position and locking the entire assembly of valve, valve retainer and valve insert.

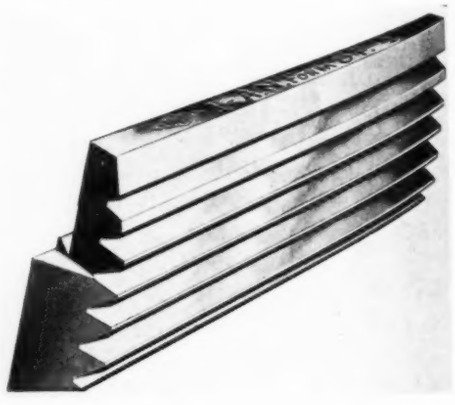
The valve seat is of one-piece construction. The taper fit for the valve seat in the cylinders is ground to exact limits in order to insure perfect fit.

The Gardner-Denver Company, Quincy, Ill., is distributing a new four-page two-color folder containing illustration and all information about this new mud pump valve.

Landis Ground Thread Chasers

THE Landis Machine Co., Inc., of Waynesboro, Pa., has developed and placed on the market a ground thread chaser. The company asserts that through a new thread-forming process which is made on a special grinding machine that the minor inaccuracies and distortions resulting from heat treatment are removed and that a uniform thread is formed with a flat crest and root that will give an unusual degree of thread accuracy, and because of a freer cutting action the life has been increased.

Landis ground thread chasers are now available for all sizes of Lanco and Landex heads and for the ⅝-inch, ⅞-inch, 1¼-inch and 2-inch Landmatic heads.



Novel X-Ray Plant for Babcock & Wilcox

THE St. John X-Ray Service Corporation, 505 Fifth Avenue, has installed what it claims to be the first X-Ray plant of its kind at the Barberton, Ohio, works of The Babcock & Wilcox Tube Company.

The photographic apparatus will be used primarily for routine inspection of welded seams in pressure vessels, heat exchangers and similar equipment.

Mud-Flux Is New Sulco Product

THE Sullivan Co., of Memphis and Montreal, has recently announced an addition to its products. The new Sulco product has been given the name of Mud-Flux, which is compounded for the specific purpose of facilitating the handling of the mud problem in the oil fields. It is a liquid whose chemical composition has been tested, and used with demonstrated results.

Mud-Flux is used in the proportion of one gallon to approximately ten barrels of mud. It is simply injected into the slush and enables the operator to make a mud of any weight. The manufacturers state that Mud-Flux cuts down the viscosity and reduces the heaviest of muds to a liquid easily pumped, breaking down gas bubbles and eliminating feathering, and brings the mud into a more compact mass, in other words, fluxing it into a flowing consistency.

The Sullivan Co. is also the originator of Gelite, Liquid Black, an agent whose action is the opposite from Mud Flux as it thickens the mud instead of thinning it out.

Further details on this new mud-mixing agent may be secured from The Sullivan Co., of Memphis and Montreal.

Air-Break Explosion-Proof Motor Starter

THE Louis Allis Co., Milwaukee, Wis., has just placed on the market an air-break "explosion-proof" motor starter which, according to the manufacturers, is the first ever to be developed. This new Louis Allis starter, known as Type E, Form AAA, is built on the same principle as the Louis Allis "explosion-proof" motor.

Both starter and the motor are built to withstand the force, and prevent the escape of flame from any explosion likely to occur inside the apparatus due to grounds, burn-outs, etc. The starter proper consists of the usual across-the-line air-break magnetic contactor with overload and under-voltage protection. The strength to withstand explosions is provided by a very heavy cast-iron case designed to withstand the worst explosion likely to occur, with an ample factor of safety. The cast-iron cover is held on the case by ten heavy cap screws. Wide machined surfaces, and very tight joints between the case and cover, cool and prevent the escape of flame even if explosive vapors enter due to "breathing" and are ignited inside the starter.

Motor Starter

AN ENTIRELY new development for the control of high voltage A. C. Motors is announced by The Electric Controller & Mfg. Co., of Cleveland, Ohio. It is a new 2300-volt motor starter for full voltage starting of squirrel cage and synchronous motors and for primary control of slipring motors. The new starter is an adaptation of a switchboard circuit breaker for controller duty, but is a contactor-type starter of very sturdy mechanical construction, specifically designed with high arc-rupturing capacity, with all parts built to meet the severe service encountered in controller operations.

Working parts are few in number and are totally oil-immersed. There are no exposed parts, such as bell cranks, toggle mechanisms or lever systems.

The contacts used on these are likewise a radical departure from previous high-voltage designs. They are made of pure hard-drawn copper and are designed to open and close the circuit with a wiping and rolling action, and can be renewed easily when worn. The totally enclosed, oil-immersed unit construction provides a dust-proof, corrosion-proof and flame-proof unit that may be mounted anywhere with perfect safety.

Additional information can be secured from The Electric Controller & Mfg. Co., by asking for bulletin 1062-F.

Foxboro Presents Steel Spring Gauges

THE Foxboro Company, of Foxboro, Mass., perfected during the past year an alloy-steel helical spring movement for their recording gauges. This new Foxboro Gauge Movement is of one-piece tubing—all steel and all welded. It combines maximum safety with high resistance to commonly encountered corrosive agents.

During the past two years Foxboro has placed these steel welded movements in high pressure work in central stations, casing and tubing work in the natural gas field, cracking units at refineries, and in various other industries.

The alloy-steel movements can be specified with all new Foxboro recording gauges or may be ordered separate to be installed in old Foxboro recording gauges now in operation. The new movements are used on gas, water, steam, oil, air, brine, chemicals, etc., where the pressures do not exceed 2,000 pounds per square inch. With the introduction of this new gauge movement The Foxboro Company has prepared bulletin 168 which describes these gauge movements in detail. Copies may be had by writing to the company.

TIME *and* TROUBLE SAVERS

Fuller's earth, after it has been spent in use in refining operations and has become refuse, can be used for protecting exposed valves and connections in the field against freezing weather. This material will not pack, nor will it take up any moisture, hence can be easily removed for examination or repairs to the fitting.

H. C. Wells, Lone Star Gas Company, Petrolia, Texas, tells in a recent issue of that company's house organ, "The Blue Blaze," that by bolting a piece of old automobile tire casing to the bottom of a ladder it may be prevented from slipping on concrete floors.

An efficient arrangement for handling sucker rods at shallow pumping wells, where tractors, portable hoists or pulling machines are used for pulling, is obtained by drilling, a few feet from the well, a rat hole about the depth of a stand of rods and of sufficient diameter to accommodate the total string. The hole may be lined with casing, galvanized corrugated pipe or old well conductor casing. As the rods are pulled they are stacked in the rat hole. This protects them from injury and from accumulating dirt. This method of handling rods was observed on a lease of the Union Oil Company of California.

To approximate the proportions of two oils to be blended to obtain a desired gravity, find the numerical difference in degrees Be between the blend and the lower gravity oil, this will give the proportional number of parts of the higher gravity oil. Similarly, to obtain the proportional number of parts of the lower gravity oil, find the numerical difference in degrees Be between the blend and the higher gravity oil. Example: Two oils of 33 degrees Be and 21 degrees Be to be blended to a desired gravity of 26 degrees Be. The difference between 26 and 21 is 5, and between 26 and 33 is 7. The blending proportions are therefore 7 parts of 21 degree oil to 5 parts of 33 gravity oil.

Whenever pumping rods have been pulled and it is impossible to run them back into the hole before nightfall, it is a good practice to cover them so as to protect them from the dew and moisture which is in the air at night. This may easily be done by using a piece of canvas.

In order to raise the pressure valve on a tank car for releasing pressure, the Texas Pacific Coal and Oil Company at Fort Worth use a large swage nipple with a hook on a screw arrangement. The hook is put in the hole on the pressure valve and by turning up simply raises the hook and the pressure valve, releasing the pressure.

Pipe, rods, tubing and other outside threaded equipment is very easily and often times injured in hauling and moving by the threads striking another object. This can best be protected by the use of protective caps. These fit over the threads and prevent injury to this important portion of such equipment, and result in extensive economies.

A rough approximation of the capacity in barrels (42 U. S. gallons) per 1,000 feet of pipe or casing may be quickly found by squaring the inside diameter in inches.

Field repairs to worn or loose rings on a gate valve disc have frequently proven unsatisfactory. Most of the trouble arose because companies were not equipped with facilities to press the rings in position in a manner so they would hold for any great length of time. Many times the rings were riveted in position and gave good service.

One company is successfully making repairs to worn or damaged rings by removing the old ring and bronze welding in the ring groove instead of pressing in or riveting in a new ring. The valves are sent to the shops in lots or singly. One of the shop welders uses a bronze rod to fill in the groove. The weld is then faced down until it seats snugly. This method has the disadvantage of having a solid disc, which, when worn, cannot be repaired by putting in a new ring.

Where the manifolds at a station delivering oil with a battery of reciprocating pumps is subjected to high momentary shocks of dangerous pressure caused by pump pulsations, it often results in the manifolds giving considerable trouble from leakage and breaks. One company with manifolds located quite close to the station reduced trouble from this source to a negligible degree by connecting the suction and discharge lines to the manifolds with flexible couplings of the rubber ring type. These couplings not only cared for a small amount of misalignment but likewise for a sufficient amount of contraction and expansion to prevent the pounding effect of the pump pulsations from exerting their full force on the manifolds.

In making repairs to cracked water jackets on Diesel engines or repairing cracked frames, repair crews with an expert welder attached to the crew have found that more permanent and neater appearing repairs may be made by doing "dental work" in connection with the repair. If the crack is a small one small bolt holes are drilled along both sides of the crack. In these iron bolts are screwed and cut off flush with the jacket or frame. The welder then starts welding, lacing the weld back and forth across the crack to the bolts, where it will fuse to the iron, and then join the lacing into one solid strip.

On larger cracks and especially on jackets of horizontal engines, a better piece of work is accomplished by drilling a horizontal hole and inserting a larger diameter bolt in that hole. When the filler weld is made the rod metal will fuse with the metal in the bolt. On the top side of the crack the same procedure is followed as outlined in the preceding paragraph.

The Pure Oil Company's gasoline plant at Van, Texas, has an automatic level control installed on the hot water sump. The device consists of a float and a system of levers for opening and closing a gate valve on the discharge of a centrifugal pump as the water level rises or lowers.

OXWELD SETS THE PACE • • • •

With every major development in the use of high-strength steels, Oxweld has been first to supply rods specifically designed to produce welds of tensile strength equal to, or greater than, the metal itself.

As a result, there are, today, three Oxweld rods covering the whole range of high-stress steels:

Oxweld No. 7—for years the standard soft iron rod for strengths up to 50,000 lb. per sq. in.

Oxweld No. 1 H. T.—the original high-test, self-fluxing, deoxidizing rod for strengths up to 70,000 lb. per sq. in.

Oxweld No. 22 S. D.—(Strength and Ductility)—the latest product of the Union Carbide and Carbon Research Laboratories, Inc.—for high-carbon steel with tensile strengths up to 100,000 lb. per sq. in.

OXWELD

WELDING AND CUTTING APPARATUS AND SUPPLIES

THE LINDE AIR PRODUCTS COMPANY

Unit of Union Carbide and Carbon Corporation

UCC

General Offices · Carbide and Carbon Building, New York

District Offices—Atlanta · Baltimore · Birmingham · Boston · Buffalo · Chicago · Cincinnati · Cleveland · Denver
Detroit · El Paso · Houston · Kansas City · Los Angeles · Memphis · Milwaukee · Minneapolis · New Orleans
New York · Philadelphia · Pittsburgh · St. Louis · Salt Lake City · San Francisco · Seattle · Tulsa

When writing THE LINDE AIR PRODUCTS COMPANY, *please mention The Petroleum Engineer*

RUNNING TOUR With Men In The Industry

Frank O. Prior

Frank O. Prior, formerly president of the Dixie Oil Company, which was merged with other companies to form the Standolind Oil & Gas Company, subsidiary of the Standard Oil Company of Indiana, has been elected president and director of the Standolind company. Other officials of the Standolind company are A. M. McCorkle, vice-president, secretary-treasurer and director; E. F. Bullard, director, and F. J. Feleher assistant secretary and assistant treasurer.

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Emby Kaye, for many years superintendent of the Skelly Oil Company natural gasoline department, has been placed in charge of all manufacturing for the company. This will include the natural gasoline plants, refineries and Skelgas. Mr. Kaye will continue to make Tulsa his headquarters.

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D. W. Boylan, vice-president and treasurer of General Paint Corporation's Hill, Hubbell Division, with headquarters in San Francisco, is making an inspection trip in the Tulsa territory. He came to Tulsa from Chicago and eastern points.

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J. J. Allinson is the new manager of the manufacturing division of the Lion Oil Refining Company, El Dorado, Ark. Mr. Allinson was formerly with the Empire Oil & Refining Company and the Pierce Petroleum Corporation, and more recently in Europe, where he was in charge of foreign operations of Arthur G. McKee & Co.

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J. Martynik, petroleum technologist and late manager of the Egyptian Central Oilfields, Ltd., is at present resting in London. Mr. Martynik has been associated with the oil industry for over 20 years.

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O. G. Wallace, tool-pusher for the Pioneer Drilling Company, Seminole, Okla., is back on the job after a recuperation trip to Hot Springs, Ark.

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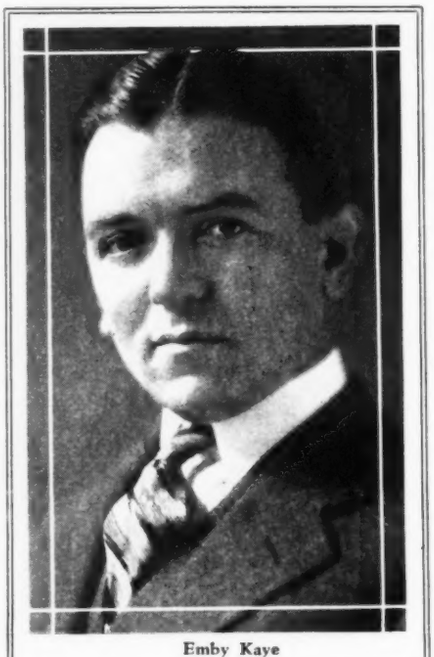
H. J. Peterson, former salesman at the Bridgeport Machine Company's store in Oklahoma City, is now office man at the Maud (Okla.) branch.



Emby Kaye

C. S. Carter, field representative for the American Well Works of Aurora, Ill., and located in Tulsa, sailed on December 31st for Colombia and Venezuela, South America, on a business trip.

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G. T. Yost, former resident chemist at Marcus Hook for the Pure Oil Company, is now at Muskogee, Okla., as assistant superintendent of that refinery. He takes the place of H. L. Smith, who has been transferred to Toledo as assistant superintendent.

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F. T. Jones, until recently drilling supervisor in the northern district of the Oklahoma City field for the Indian Territory Illuminating Oil Company, has been promoted to superintendent of drilling and production for the company in the Texas Panhandle area. Headquarters will be at Amarillo.

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Mark D. Woolery has been appointed general manager of the Del Rey Oil & Refining Company, Ltd., with Los Angeles as headquarters. He was formerly general superintendent for the Ohio Oil Company of California.

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Floyd Huff, division gas engineer for Standard Oil of California at Los Angeles, is now making his headquarters at the San Francisco office. He has been promoted to the position of being in charge of the gas division for the entire coast.

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Walter Swaney, general manager of the Kerotest Mfg. Co., Pittsburgh, Pa., visited Gulf Coast territory in December.

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C. B. (Boots) Kennedye has acquired a substantial interest in the Metal Forms Corporation of Milwaukee, and has been elected vice-president in charge of all southern and western states. Boots, for the past five years, has been president of the Kennedye Plumb Corporation, and for ten years previous was southwest district manager of the Brown Instrument Company. He is also the president of the Kennedye Corporation of Chicago, associated with C. B. Dubbs, and is interested in a number of other oil field specialties and equipment.

C. B. Kennedye

The men in this picture, left to right, are:

J. K. Potts of the Ward Drilling Co. and his grandson Dickey Stout.

Ed Willet, shooter for the Agnew Torpedo Co.

M. G. Jameson, Dist. Sup't for the East Ohio Producing and Refining Co.

S. E. Swallow, M. C. Cox, J. H. Dawson, R. G. Hostetter, and D. E. Cox rig building crew of the rig contracting firm of Swallow and Swallow.

H. A. Sater, scout of the Ohio Fuel Gas Co.

C. P. Trowbridge in charge of tools for the Gordon Oil Co.

Adam Rohrbaugh who completed this well and is one of the oldest active drillers in the east, having begun drilling at Callery Junction, Pennsylvania, in 1888.

J. W. Blacksten, President and General Manager for the Capitol Drilling Co.

G. L. DeVore and J. F. Grey, cleaning out men.

F. R. Shumaker in charge of the trucking for the Capitol Drilling Co.

L. A. Liddle owner of the land on which this well was drilled.

UNION has lots of friends at Cambridge, Ohio

THE above photograph, taken at Liddle No. 2 in the Cambridge territory, is typical of scenes in this district because it shows a UNION Drilling Line which has completed this well and is ready for the next location.

UNION Wire Lines make friends everywhere by being of staunch character - - by serving with emminent satisfaction under all conditions.

UNION WIRE ROPE CORPORATION
3 North Madison Ave., Tulsa, Oklahoma
Oil Country Sales and Export Offices: 338 Kennedy Bldg., Tulsa
Branch Office and Warehouse: Portland, Ore.
Factory: 21st and Manchester, Kansas City, Mo.

JARECKI MANUFACTURING COMPANY
Mid-Continent and Eastern Oil Field Distributors - - Stocks at All Stores

UNION WIRE ROPE CORP. TRADE MARK

UNION WIRE LINES

When writing UNION WIRE ROPE CORP., *please mention The Petroleum Engineer*

Garrett B. Linderman, Jr.

Garrett B. Linderman, Jr., has joined the organization of the Pittsburgh Equitable Meter Company and will be located at the main office in Pittsburgh, Pa. Mr. Linderman, who was for a time connected with the Bethlehem Steel Company and more recently with the Metric Metal Division of the American Meter Company, is a Lehigh University man and is well known in the gas industry. The Linderman orifice meter is primarily his invention.

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Harry N. Royster, in charge of the Goodall Semi-Metallic Hose & Mfg. Co. business in the San Antonio, Texas, territory, was a recent visitor in the company's factory in Philadelphia.

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F. W. Lake has been promoted to the position of general superintendent of the Southern Division of the Union Oil Co., of Los Angeles. He will have charge of all Union company drilling and production operations in the oil fields of the Los Angeles basin. Mr. Lake has been with the Union since 1922 and until his promotion was production superintendent of the Southern Division.

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C. E. Reasoner has been transferred from the Bridgeport Machine Company store at Hobbs, N. M., to the store at Pampa, Texas, where he is serving in the capacity of office and warehouse man.

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J. Paul Getty, president of Geo. F. Getty, Inc., is in Europe investigating conditions in the oil industry.

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Clarence L. Wingate has become production superintendent for the Droppleman Drilling Company and associated oil interests. Wingate previously was with the Prairie Oil & Gas Company for 17 years, rising from the position of clerk in the production department to the rank of assistant superintendent of production under John A. Wolfe.

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Don Cunningham, engineering department, Indian Territory Illuminating Oil Company, Seminole, Okla., is the proud father of a baby girl born on November 30.

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L. D. Scott

L. M. C. Searmark and L. D. Scott, of the field department of the Anglo-Persian Oil Company, are making a tour of the oil fields of the United States, studying the latest developments in drilling and production equipment and methods of operation. They spent a few days in Tulsa recently. From Tulsa they were going to the Gulf Coast fields, then to California. They expect to return to Persia some time in March.

Harry A. Kassebaum

Harry A. Kassebaum, well-known oil tool sales executive, has been appointed to the position of sales manager for the newly-formed Rapid Fire Prevention Company, Ltd., manufacturers of Rapid water-fog-operated fire prevention equipment. For the three and one-half years previous to the acceptance of his new position he was sales manager for the Elliott Core Drilling Company. Mr. Kassebaum has been actively connected with the oil industry since 1910. He started with the Esperanza Consolidated Oil Company in Coalinga, Calif. It was absorbed by the General Petroleum Corporation. Later he served as assistant to the president of the California Petroleum Corporation during the terms of W. I. Fuqua and R. L. Peller. Mr. Kassebaum is a charter member of the "Wildcats" committee of the California Oil and Gas Association and is also active in the local American Petroleum Institute. His offices will be at the headquarters of the Rapid Fire Prevention Company, Ltd., 1520 East Slauson Avenue, Los Angeles.

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Arthur J. Foley has been appointed manager of Neilan Co., Ltd., Chicago branch office. His office will be at 55 East Wacker Drive, Chicago. Mr. Foley is widely known throughout the Mid-Continent because of his years of experience in connection with numerous industrial plant installations.

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Claxton E. Allen, formerly manager of the Southwestern District of the Westinghouse Electric and Manufacturing Company, was elected a commercial vice-president of that company at a recent meeting of its board of directors. Mr. Allen has assumed his new duties with headquarters in Pittsburgh, Pa.

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A. H. Proctor, Magnolia Petroleum Company district superintendent in the operating department at Laredo, Texas, has been transferred to Cement, Okla., and C. A. Hill from Cement to Laredo district, with Mirando City as headquarters.

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Weston Payne, petroleum engineer, Trinidad Lease Holds, Ltd., at Trinidad, British West Indies, and his family spent the holidays with Mrs. Payne's parents in Lonoke, Ark.

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F. W. Peek, Jr., was appointed chief engineer of the Pittsfield (Mass.) works of the General Electric Company, effective January 1. Mr. Peek joined the company in 1905 and, upon the organization of the consulting engineering department in 1909, he was one of the first to join it and has been in that division until this time.

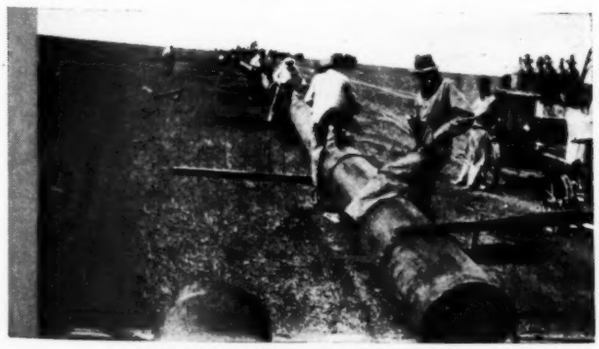
L. M. C. Searmark

THE LAYING OF THE AJAX DOUBLE 10-INCH AND THE PANHANDLE-EASTERN 22-24-INCH ...MADE PIPE LINE HISTORY IN 1930

Railroad Crossing of Ajax Double 10-inch Line at Wood River, Illinois. Twenty-nine railroads were crossed by the Ajax Line.

Ajax Double Line Crossing Missouri River. Six major rivers were crossed by this line.

The Panhandle-Eastern 22-inch Line under construction near Gruver, Texas.



Welding on the Panhandle-Eastern 22-inch Line near Gruver, Texas.

Unique in the annals of pipe line construction was the Ajax Line. Two 10-inch pipe lines were laid side-by-side in separate ditches simultaneously for a distance of 400 miles—from Jenks, Oklahoma, to Wood River, Illinois. Both lines were acetylene welded, painted and wrapped in saturated felt.

The Oklahoma Contracting Corporation laid the first length of pipe on June 26, 1930. Exactly five months later and *35 days before the contract specified time* the Ajax Line was completed.

Construction on the Oklahoma Contracting Corporation's 309-mile portion of the Panhandle-Eastern, formerly the Missouri-Kansas, Pipe Line began May 26, 1930. By September 26, 109 miles of 22-inch line had been completed, with three joints welded to one coupling. Nearing completion is the 200 miles of 24-inch coupled line.

The Oklahoma Contracting Corporation laid over 1,600 miles of pipe line in 1930. This record of achievement, a company policy of having all equipment on the ground the day before it is needed and of buying new equipment whenever it will speed up the job, and an efficient organization of competent executives and workmen make the Oklahoma Contracting Corporation's bid on any job the most economical, although it may not be the lowest.

OKLAHOMA CONTRACTING CORPORATION

Formerly OKLAHOMA CONTRACTING COMPANY

Pipe Line Engineers and Contractors

General Offices: Allen Building, Dallas, Texas
Branch Office: Oklahoma Gas Building, Tulsa, Okla.

John Collins, Jr., is now chief engineer for the Standard Management and Operating Corporation of Chicago, Ill. He comes from the New York offices of the United States Engineering Corporation, where he was vice-president and chief engineer. Mr. Collins will be in charge of all construction and engineering phases performed by the Standard Management and Operating Corporation and its subsidiaries.

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Charles L. Gladden, district superintendent in the Wewoka (Okla.) area for the Magnolia Petroleum Company, has been made assistant general manager of production and will move to Dallas. O. H. Stout succeeds Mr. Gladden as Wewoka district superintendent.

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Clive M. Alexander, formerly in charge of manufacturing for Imperial Refineries and its subsidiaries, is now engaged in consulting work with offices at 909 Atlas Life Building, Tulsa.

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E. J. Nicklos, vice-president in charge of production, with W. W. Bruce, vice-president and assistant to the president, Continental Oil Company, Ponca City, Okla., have made an inspection trip of some of the company holdings in Texas, including the division office at Fort Worth.

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Gray I. Morris has been appointed Eastern representative for the Kerotest Manufacturing Company of Pittsburgh, Pa., and will make headquarters at the new Kerotest offices which have been opened at 958 Graybar Building, New York City. Mr. Morris for many years was manager of the Refinery Products Division of the American Radiator Company.

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Paul Shunkey is placed as supervisor of District No. 1, comprising the Bodine gasoline and gas lift plants, Bodine office and laboratory, Button gasoline and gas lift plant, Button skimming plant, Jones gasoline and gas lift plant and the Flynn loading rack, in several changes made in the operating personnel of the gasoline and gas lift plants of the Indian Territory Illuminating Oil Company at Oklahoma City.

C. D. McReynolds is supervisor of District No. 2, comprising the Lemmon gas lift plant, Fox gas lift plant, Verne gasoline and gas lift plant and the Farley gasoline and gas lift plant.

H. B. Owens

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George Leigh-Jones, president of the Shell Oil Company of California, is en route to London and The Hague, where he will confer with Shell officials on the oil situation. Mr. Leigh-Jones is also a director and member of the executive committee of the Shell Union Oil Corp.

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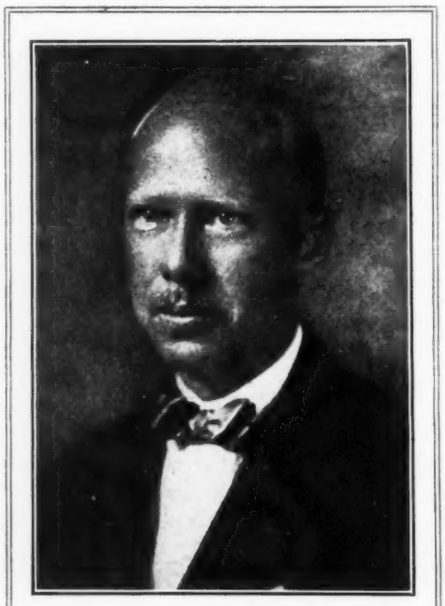
H. B. Owens has recently been appointed pipe line representative for the Caterpillar Tractor Co. He will maintain headquarters in Tulsa.



Gray I. Morris

Maxcine J. Japour, formerly chief chemist for the Champlin Refinery at Enid, Okla., is now employed as chemist for the Shell Petroleum Corporation at its Norco Refinery at Sellars, La.

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Winn Stout, who has for many years been identified with the sale and distribution of oil well equipment in California, has been retained by the Specialty Oil Tool Company of Los Angeles as its sales representative in connection with the Sotco mud weight recorder. Mr. Stout is at present in the Mid-Continent and Gulf Coast territories introducing this new mud weight recorder.

Maxcine J. Japour

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Jack C. Ballagh, secretary of Patterson-Ballagh Corporation, has returned from a two months trip to Europe in the interest of Bettis protectors. Mr. Ballagh laid plans for an expansion of field service in the distribution of these products. On his return trip to Los Angeles he visited principal oil fields in the Mid-Continent. Mrs. Ballagh accompanied him.

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William C. McDuffie, president of the Pacific Western Oil Company, has been elected president of the Richfield Oil Company of California. He succeeds C. M. Fuller, resigned. New directors elected were Harry J. Bauer, C. H. O'Neil, H. H. Cotton, John Treanor and Joseph P. Loeb, who succeed five resigned directors.

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John M. McGregor will be factory engineer for the Chapman Valve Mfg. Company effective February 1st, 1931. He will make his headquarters at Tulsa, Okla., with the Taubman Supply Corporation, Mid-Continent factory representatives. Mr. McGregor graduated from Heriot-Watt Technical College and the University of Edinburgh, Scotland, with the degree of B. Sc. He became engaged as consulting engineer for power plant installations in France, and later was in charge of various munition factories for the British Government in England. For five years he was special lubricating representative for pipe line work of the Standard Oil Company of Indiana, and during 1930 was Sales Engineer for Byron Jackson Pump Company, with Tulsa as his headquarters.

John M. McGregor

When better Core-Barrels are designed . . . . .

Perfection

will be their name!

TYPE "M" BIT BODY

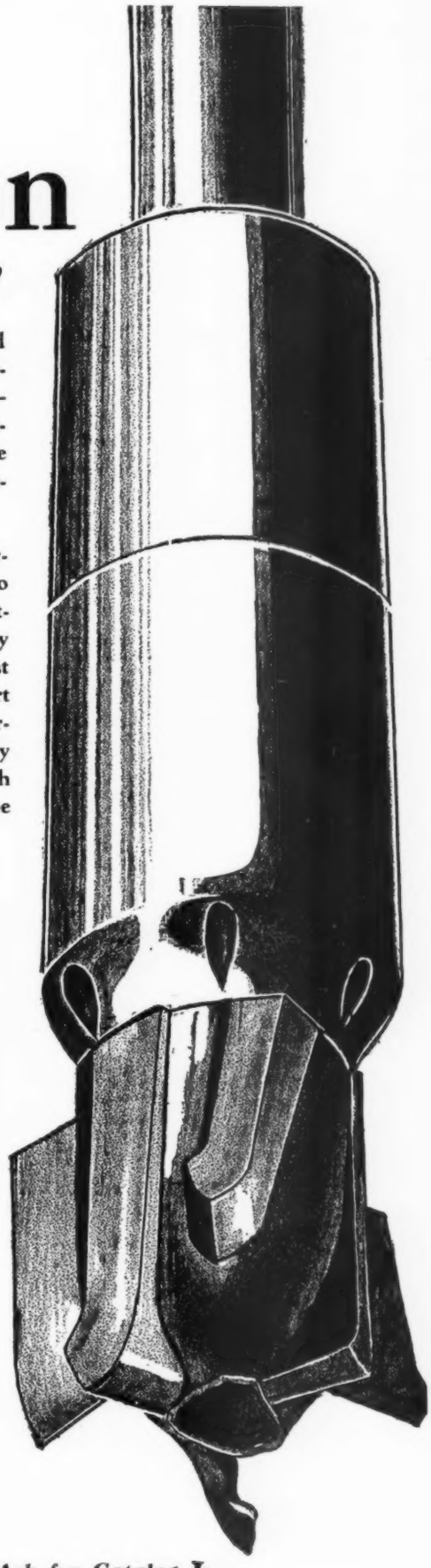
Constant advances in design, backed by precision manufacture in finely-tooled, splendidly manned shops—that is why 9 out of every 10 contractors give the Perfection Core Barrel the same unqualified endorsement.

The latest is the Type "M" Perfection Core Barrel—designed to put circulation directly on the cutting edge. The result is an efficiently cooled bit that makes hole fast through hard formations. Convert your Type "C" Perfection Core Barrels by replacing Type "C" Bit Body with Type "M". We will furnish the latter free to owners of Type "C" barrel.

TYPE "M" CUTTER HEAD

***Ask** . . . about these other Brewster A.P.I. Products.*

Include A. P. I. Shouldered Tool Joints; Perfection Core Barrels; Chrome Nickel Drill Collars; Special Fish Tail and Gumbo Bits; Core Barrel Cutter Heads for both hard and soft formations—hard formation cutter heads are faced with a substance of diamond-like hardness.



The Brewster COMPANY~INC.
Shreveport, Louisiana

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Ask for Catalog and Prices

When writing THE BREWSTER CO., INC., *please mention The Petroleum Engineer*

Edited by **BARNEY HORRIGAN**

Safety

"Do you drink?"

"No."

"Then hold this quart while I tie my shoelace."

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She was only a carpenter's daughter, but how she chiseled me!

—Bell Hop.

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Right!

Teacher: "Johnny, what word in the English language is always pronounced wrong?"

Johnny: "Wrong."

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"Are you sure this suit won't shrink?"

"Shrink? Oi! Dot suit has been watered on by effery fire department in town!"

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Protected

He: "It wouldn't be much trouble for us to marry. My father's a minister, you know."

She: "Well, let's have a try at it, anyway; my dad's a lawyer."

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Overboard

First Stewd: "Who's your close-mouthed brother over there?"

Second Stewd: "He ain't close-mouthed. He's waiting for the janitor to come back with the spittoon."

—Exchange.

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Huh!

He (with her): "Have you a room and bath for my wife and I?"

Hotel Clerk: "We have double rooms, but none with bath."

He (to her): "Will that be all right with you?"

She: "Yes, mister."

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"Who really is the boss in your house?" inquired the friend.

"Well, of course, Maggie assumes command of the children, servants, dog, cat, and the canary. But I can say pretty much what I please to the goldfish."

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Local Color

A celebrated white preacher had been engaged to address the congregation of a little negro church, and was being introduced by the very nervous colored pastor.

"Sistern an' bred'rn," he began, "it affords me the extremest pleasure to introduce de speaker of de evening. I wants to explain dat while his skin ain't the same color as de odders here, I assures you his heart is as black as any of your'n."

—Puppet.

Ups and Downs

A kindly old gentleman, seeing a man leaning limply against the doorway of an apartment house in the early hours, offered to help him upstairs if he lived there, which offer was accepted. With much difficulty, he dragged him upstairs, and not wishing to face perhaps an irate wife, he opened the first door he came to and pushed him in. On reaching the street, he made out the outline of another drooping figure, apparently in worse condition than the first one, so he offered to help him upstairs, which offer was accepted, and he was assisted to the same room as the first one. Reaching the street again, he was surprised to make out the outline of another drooping figure, but nevertheless, he again approached him to offer assistance, whereat the object of his solicitude ran into the arms of a passing policeman.

"For heaven's sake, off'cer," he gasped, "protect me from that man. He's done nothin' all night long but carry me upstairs 'n' throw me down th' elevator shaf'."

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Needed

He: "So Crankshaft has two cars now?"

Him: "Yeh, he couldn't get his accessories all on one."

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Turks Warned

It is said that the Sheiks of Morocco are buying large American automobiles in which to take the ladies of their harems riding. We warn them that it is dangerous to drive with one arm while having the other around a harem.—Detroit News.

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Humor

"Really, Bill, your argument with your wife last night was most amusing."

"Wasn't it, though? When she threw the axe at me I thought I'd split."

—Annapolis Log.

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On Account

A revivalist said to the congregation:

"There is a man among us who is flirting with another man's wife. Unless he puts $5 in the collection box, his name will be read from the pulpit."

When the collection box came in, there were six $5 bills in it, and a $2 bill, with a note pinned to it, saying:

"This is all the cash I have, but will send the other $3 Wednesday."

Care

Crabflake: "I say, old fellow, why on earth are you washing your spoon in the finger bowl?"

Codpiece: "Do you think I am going to get egg all over my pocket?"

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Bad

"Well, Abe, how's business?" asked the salesman as he breezed into the store.

"Terrible. Even the people vot don't pay ain't buying nothing."

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As the Ads Say—

"She laughed when I sat down on the park bench, but when I started to play—"

—Frivol.

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Precedent

Kind Old Lady: "And what are you going to do when you grow up, my little man?"

Urchin: "Foller in me father's finger prints."—Wampus.

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College graduates don't have to attend homecoming celebrations to see their old classmates. They hold reunions in front of employment agencies every few weeks.

—Whirlwind.

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Incomplete

Negro, at information window: "What time do yo' train git tuh Cawpus?"

Clerk: "Four-five a. m."

Negro: "Yassah, thankee, but how long er fo' five?"

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Time to Talk

"Beatrice," said Mrs. B. to her daughter, "if Harold asks you to be his wife tonight, tell him to speak to me."

Beatrice nodded, and then said: "And if he doesn't ask, mother?"

"In that case," said the mother, "tell him I want to speak to him."

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Opportunity

Senator Shortridge of California—"Why, away out yonder where the sun sets reluctantly as it bids goodnight to California—in that State which is attracting the best citizens from every State in the Union who are going there to make their homes and be happy ever after—"

Senator Robinson of Arkansas—"Mr. President, I wish to point out that neither of the senators from Florida is present."

—Congressional Record.

PICTORIAL PETROLEUM

MONTHLY ROTOGRAVURE
FEATURE OF
THE *Petroleum* Engineer

JANUARY 1931

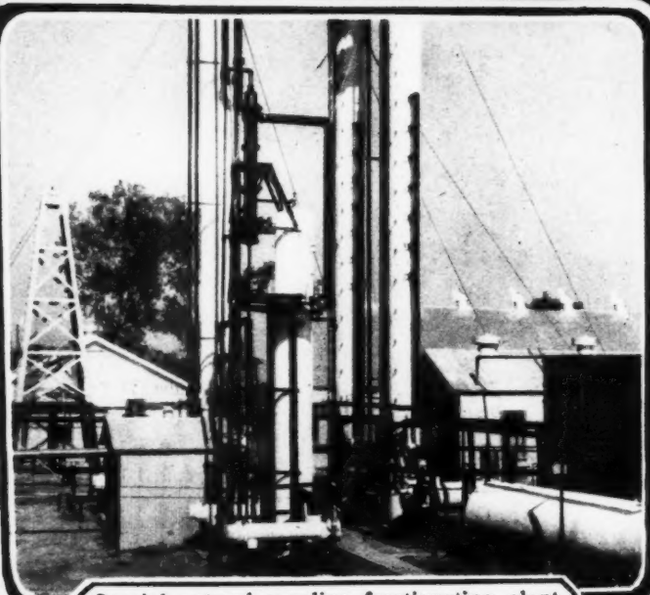
Venice-One of California's most Active Fields.

A. E. Chester, with Watson-Stillman Co., New York City.

J. Fred Miles, vice president Louisville Refining Co., Louisville, Ky.

C. B. Faught, superintendent Richardson Refining Co., Big Spring, Texas.

Norman W. Stirling, representative for M. W. Kellogg Co., New York City.



Special natural gasoline fractionating plant designed by C. F. Braun & Co., primarily for production of commercially pure pentane. Fed 25,000 gallons per hour of raw natural gasoline, it produces approximately 5,000 gallons of pentane and 16,000 gallons of grade "AA" natural gasoline.

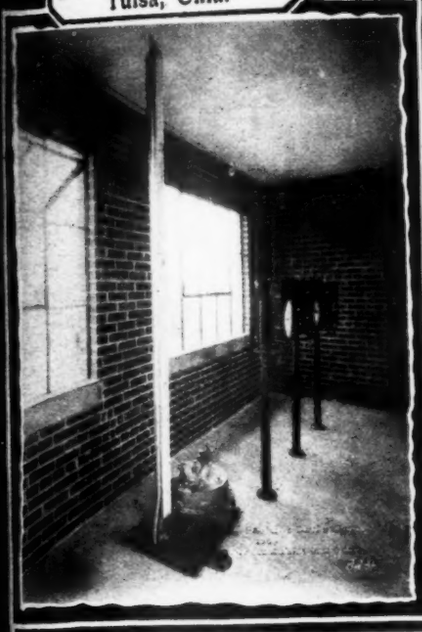
G. S. Younkin (left) and S. M. Poole, both with Brown Instrument Co., Philadelphia, Pa.

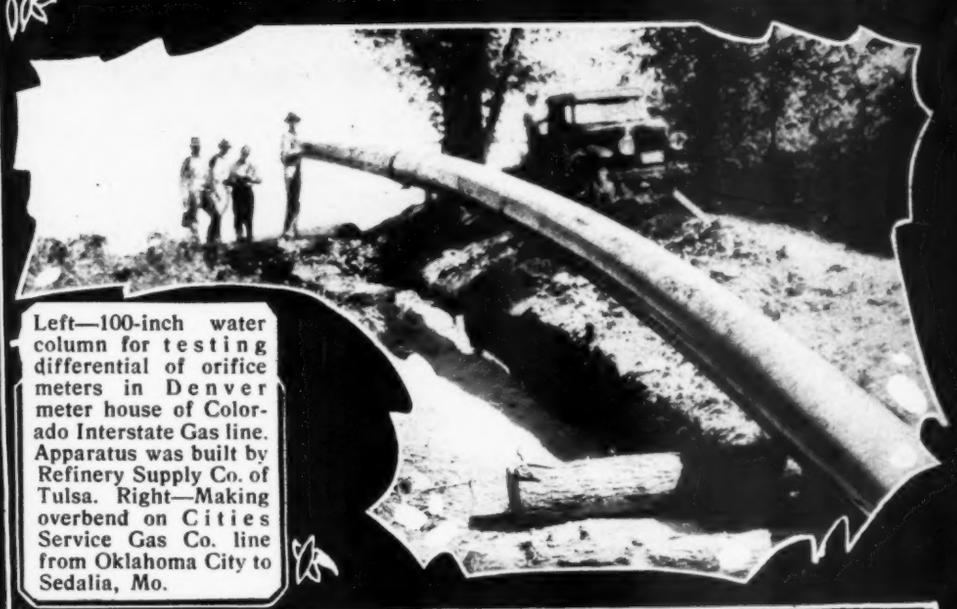
Deep Rock Oil Corporation's refinery at Cushing, Okla.

E. J. Chumlea with Henry L. Lemons, Inc., pipe line contractors, Tulsa, Okla.

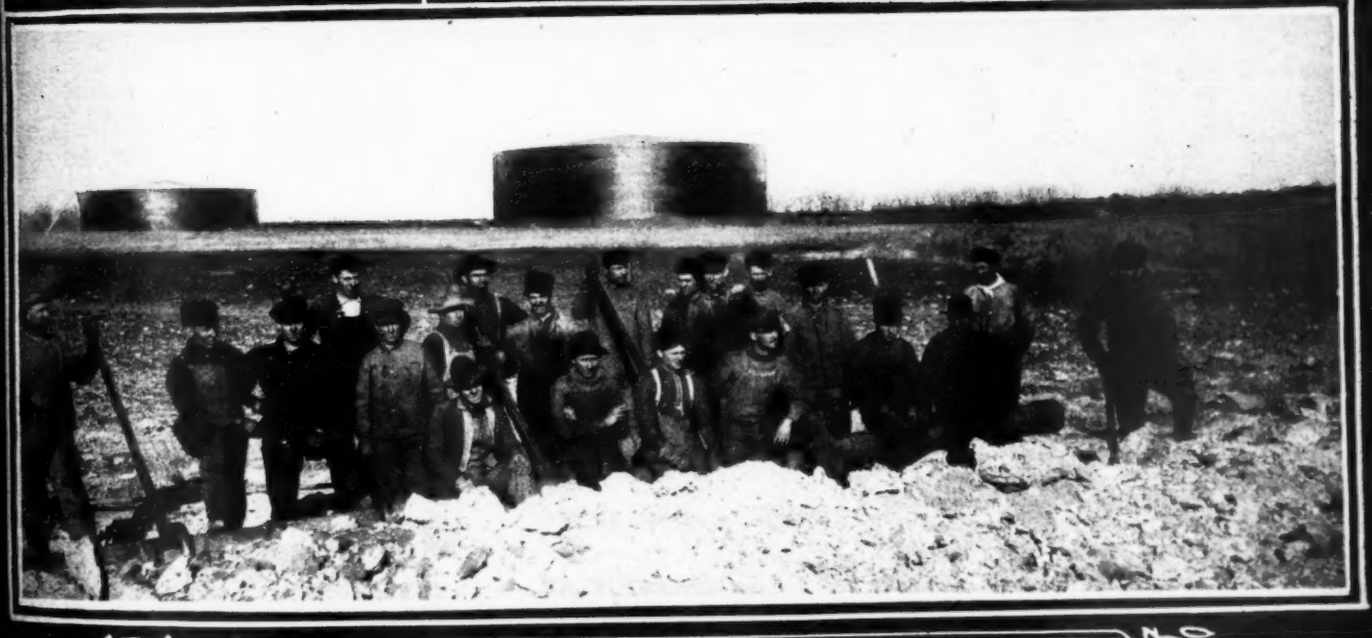
Perfection vapor pressure tank manufactured by Black, Sivalls & Bryson, Bartlesville, Okla.

A. E. Crockett, manager Bureau of Instruction, Jones & Laughlin Steel Corp., Pittsburgh, Pa.





Left—100-inch water column for testing differential of orifice meters in Denver meter house of Colorado Interstate Gas line. Apparatus was built by Refinery Supply Co. of Tulsa. Right—Making overbend on Cities Service Gas Co. line from Oklahoma City to Sedalia, Mo.



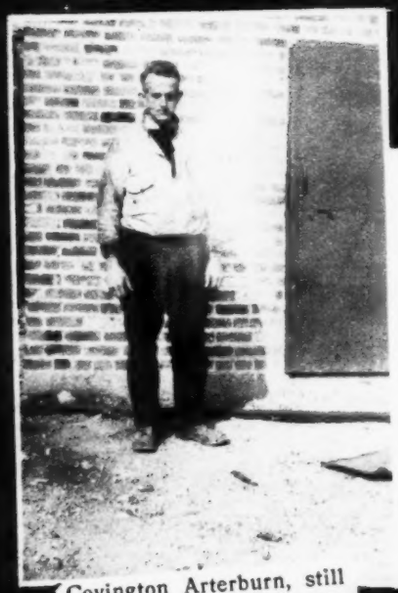
Prairie Pipe Line Co. gang laying a trunk line near Humbolt, Kans., station in 1904.

Berry V. Stoll, vice president in charge of refining, pipe lines and tank car selling.

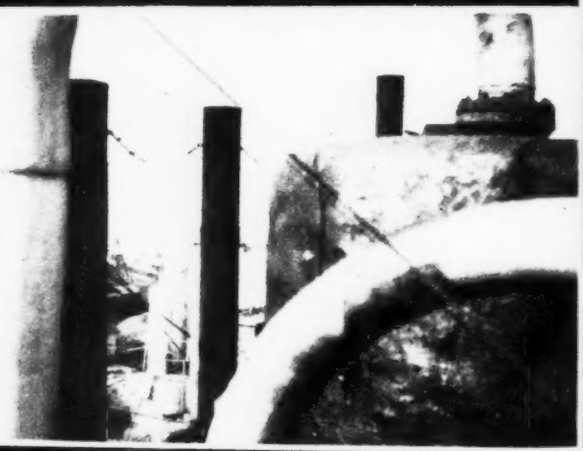
Looking down on some of the condenser boxes.

Clem S. Luce, graduate of the University of Oklahoma, who is chief chemist and is in charge of research and technical work.

Photographs on this page, showing equipment and personnel of Stoll Oil Refining Co., Louisville, Ky., are reproduced through courtesy of Berry V. Stoll, vice president of the company.



Covington Arterburn, still foreman, who is an important figure in athletics in Kentucky, having been state tennis champion for many years and one of the best golfers in Louisville.



Close-up of towers, with a continuous gasoline treater appearing in the background.

J. W. "Jack" Kittner, superintendent of the refinery, who has been with the Stoll company ten years.

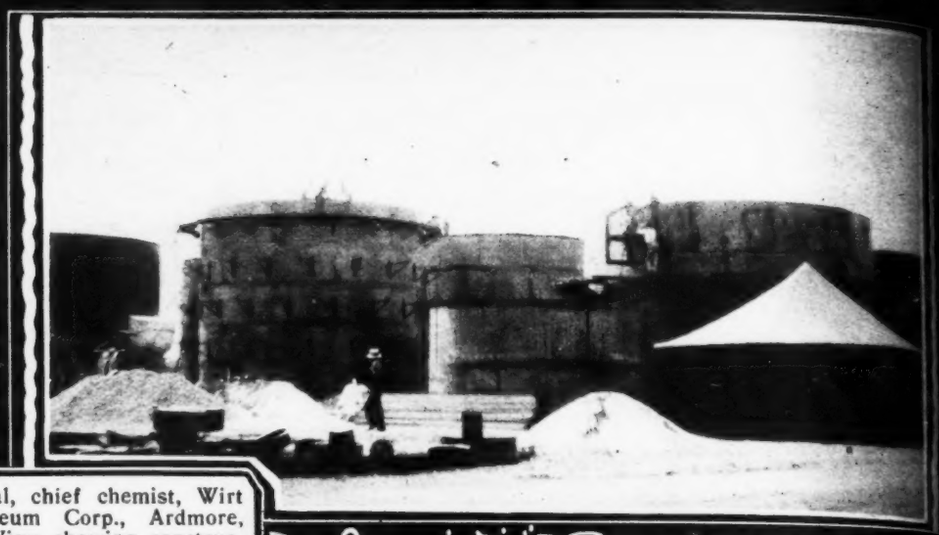
In foreground at left is the grease house; in background at right appears tower and filtration tower, which are Stoll patents.

Rundown tanks placed on the banks of the Ohio River. Crude is obtained by barge shipments as well as by tank car.

Left—Joe W. Greene, district representative for Improved Steel Gas Engine Head Co., West Tulsa, Okla. Below—Steel poles, 5-inch by 25 feet, supporting two 14-inch oil pipe lines. These are manufactured by Bates Expanded Steel Corp., East Chicago, Indiana.

Above—Paul Elfers, sales engineer for The Fisher Governor Co., Marshalltown, Ia. Right—E. S. Stephens, vice president Consistometer Corporation, Chicago, Ill.

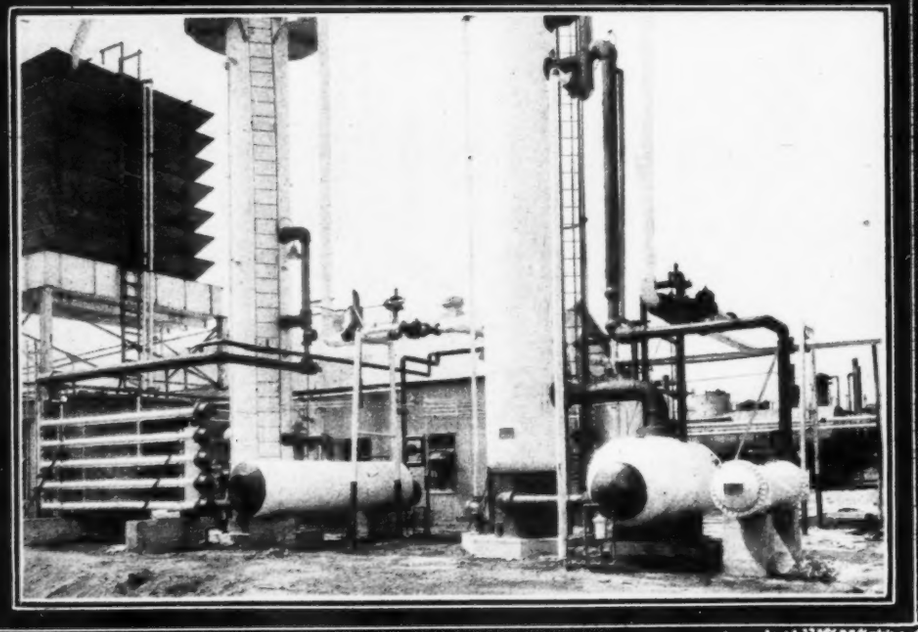
Below—Special closed type distributing system, manufactured by J. F. Pritchard & Co. for exclusive use on cooling towers. This is an Oklahoma City plant installation.



Left—Hugh Neal, chief chemist, Wirt Franklin Petroleum Corp., Ardmore, Okla. Right—View showing construction work on Continental Oil Co's. new refinery at Denver, Colo.

Fire truck of Sarawak Oilfields Ltd., Miri, Sarawak. Photo courtesy Merryweather & Sons, Ltd., London.

Left to right — W. H. Sowers, George Owen and E. S. Sieber, all with National Lead Co.

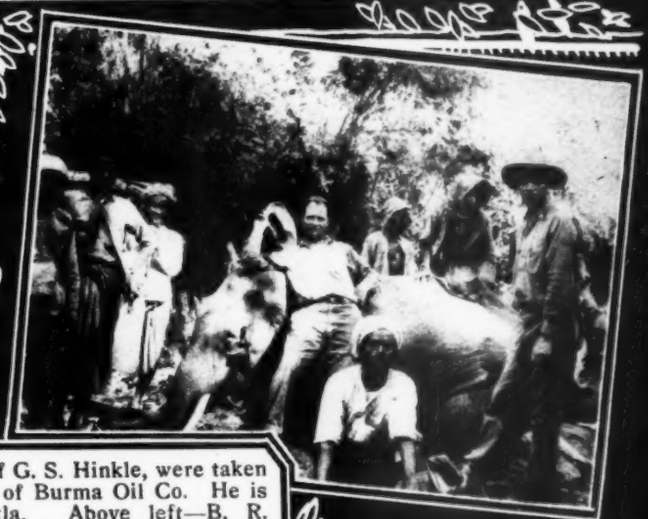


Left — Stabilization plant of the Kanotex refinery at Arkansas City, Kans., constructed by Petroleum Engineering, Inc., Tulsa, Okla. Above—Paul M. Raigorodsky of Petroleum Engineering, Inc.

L. R. Slater, general superintendent Darby Petroleum Corp., Tulsa, Okla.

Pat S. Lewis, president, Resistcor Engineering Corp., Tulsa, Okla., displaying with justifiable pride a 6-pound bass caught in Spavinaw lake.

Don C. Bothwell, vice president and general manager, Darby Petroleum Corp., Tulsa, Okla.



These four photographs, which we reproduce through courtesy of G. S. Hinkle, were taken in Burma when Mr. Hinkle was assistant drilling superintendent of Burma Oil Co. He is now with American Iron & Machine Works, Oklahoma City, Okla. Above left—B. R. Emrick (left) technical adviser, Burma Oil Co. and G. S. Hinkle, after a successful day of duck hunting. Above right—George O'Mara, drilling superintendent, British-Burma Petroleum Co. (left) and Mr. Hinkle escorting a yoke of oxen, forerunner of the modern motor truck. Below left—American Club at Chauk, Burma. Below right—Bill Taylor, driller for Burma Oil Co. (with hat removed), Tim Firestone and a group of natives photographed with an elephant killed by Taylor.

A 2,000-ft. crossing is here being laid by Natural Gas Engineering Corp. in the Canadian River near Whiteford, Okla., on the Quinton Natural Gas Co.'s 16-inch gas line.

Treating Pressure Distillate With Cupric Solution

By RICHARD H. COOK
Chief Chemist, Houston Oil Company, of Texas

THE Houston Oil Company of Texas treats its pressure distillate by the ammonio-cupric sulphate method. This method, known as the blue solution method, was developed by W. R. Hounsell. While this treatment is slightly more costly than the sodium plumbite method, chemists of this company are of the opinion that with the proper recovery of the chemicals used in the process the difference in costs of treatment by the two methods is negligible. The advantages of the method are good color, stability, reduced sulphur content, less gums, and the fact that there is no necessity for further treatment of the finished gasoline for the market.

Treating Plant.

The flow sheet shows the layout of the treating plant used for the treatment of pressure distillate using the ammonio-cupric sulphate solution. The plant has a capacity of 1,200 barrels of raw pressure distillate per 24 hours. The equipment consists of the following:

5—Shell towers 4 feet by 20 feet.
3—Pumps.
2—Mixing Coils.
2—Acid blow-cases.
2—Blue solution blow-cases.
2—Dissolving vats for copper sulphate.
1—Acid tank.
1—Doctor solution tank.
1—Blue solution tank (mixing tank).
1—Sludge tank (acid).
1—Surge tank.

Chemicals used and their proportions:

For 1,380 gallons blue solution batch, 450 pounds copper sulphate; 420 gallons 13.5 degrees Be doctor solution (sodium plumbite); 70 gallons 26.0 degrees Be ammonium hydroxide; sufficient water to make 1,380 gallons in all.

Procedure.

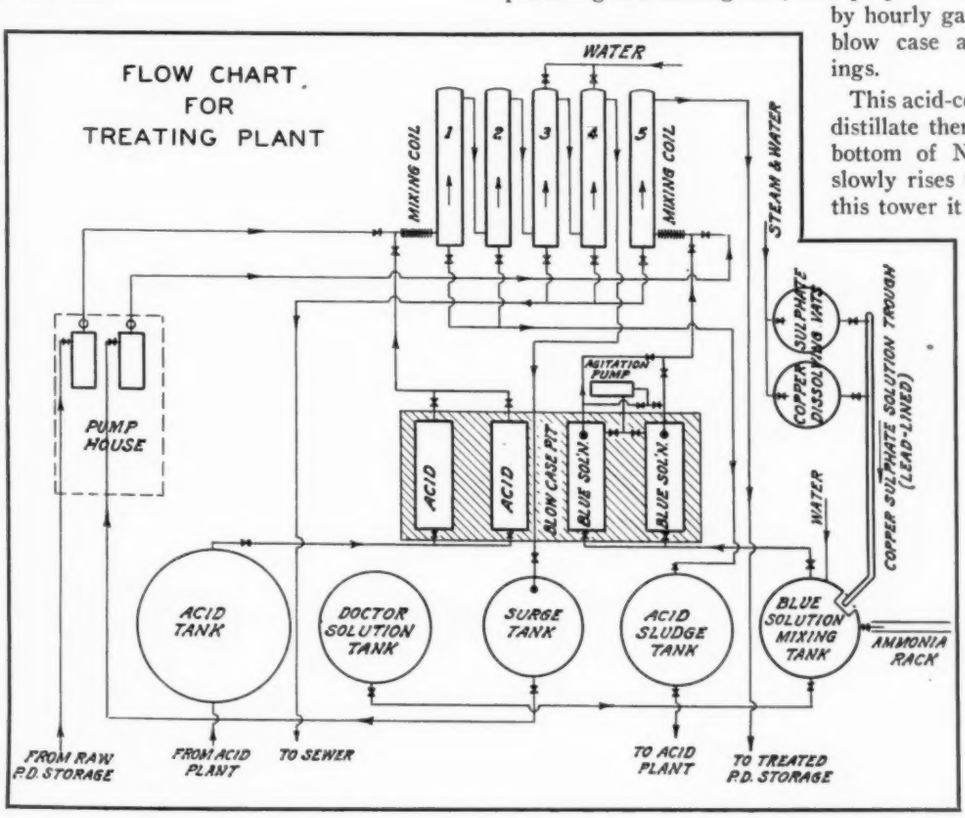
About 500 gallons of water is pumped into the copper sulphate dissolving vat, and 450 pounds of copper sulphate is added. This is boiled with steam until solution is complete. About 420 gallons of 13.5 degrees Be doctor solution is gravitated into the mixing tank. This is done first, as a precautionary measure to protect the iron tank from the copper sulphate solution. The copper sulphate solution is then gravitated into the mixing tank, and the liquids are agitated well by means of a mechanical agitator. Air cannot be used for agitation, since it would oxidize the solution. Seventy gallons of 26 degrees Be ammonium hydroxide are now added and further agitation is given the solution. This mixture contains a rather heavy precipitate which must be kept well suspended during use. After standing over night, the solution is pumped to blow cases. Agitation is maintained at this point by pump circulation.

Blue solution is more stable in cold weather, but is not as active. It should never be kept longer than 20 days since oxidation destroys its effect.

The acid blow cases contain a 60.5-degree Be sulphuric acid which is a blend of a reclaimed 59 Be acid with fresh 66 Be acid.

Treating Operation.

The pressure distillate is metered and pumped into the system. Acid from the blow case is added at a point just preceding the mixing coil, and proportions are maintained by hourly gauges on the acid blow case and meter readings.



This acid-contacted pressure distillate then passes into the bottom of No. 1 tower and slowly rises to the top. From this tower it is carried to the bottom of No. 2 tower, where it again goes through a settling stage. Acid sludge is drawn off of the bottom of one and two towers. The distillate passes on to the bottom of No. 3 tower. From the top of No. 3 tower it goes into the bottom of No. 4 tower. Both 3 and 4 towers are equipped with water

HERE'S A NEW McEVOY STRAINER FOR NEW YEAR OIL PROFITS

OLDTIMERS in the oil industry who swear by the McEvoy Strainer need not feel that we have disregarded their reasons for specifying the "McEvoy Wireless." We have not. We have simply made better what they like in strainers.

A new process, which has been under development by McEvoy Engineers for several years, has recently been made standard practice in the McEvoy Factory.

This process results in improvements that are astounding in spite of the fact that the previous McEvoy Screen had never been excelled.

You Will Like These New Advantages

Each button is imbedded in the pipe on a heavy shoulder.

The metal of the pipe is flowed around the circumference of the button in effect, making the insert and the pipe one piece.

The slot width is, of course, held within very close limit.

J. H. McEVOY & COMPANY

PACIFIC COAST BRANCH: McEVOY SCREEN PIPE CO., 2428 E. 56 ST., LOS ANGELES, CALIF.

THOSE who have seen and are using the NEW IMPROVED McEVOY STRAINER with case-hardened or brass strainer plugs, have been impressed with its new features. It is a true example of the work of McEvoy engineers who are constantly experimenting in advance of present methods and requirements. Their recent creation, the NEW IMPROVED McEVOY STRAINER, is a clear step forward in making a good strainer better.

At This Time Forward Looking Oil Men

are planning to make every dollar invested in production bring back the maximum in profits. Such men choose a strainer with great care, knowing that such a choice immediately affects profits.

Start the New Year by making special effort to see the NEW IMPROVED McEVOY STRAINER . . . . or send for NEW CATALOG.

sprays for washing the distillate free of acid (at this point the author would suggest addition of a weak caustic wash to make the distillate basic in preparation for the blue solution treat which is ammoniacal. Much loss in ammonia is caused by neutralization of the acid left in the distillate, whereas caustic would be a much cheaper reagent).

After the two stages of water wash and settling, the distillate is conveyed to a surge tank to maintain a constant supply of the blue solution treatment stage. From the surge tank the distillate is pumped into another mixing coil where it is contacted with the blue solution, as in the case of the acid. There is only one tower used at this stage. The distillate, mixed with blue solution, enters the bottom and the distillate slowly rises to the top where it goes out to the treated pressure distillate storage, leaving the spent solution to be drawn off of the bottom of the tower.

The amount of blue solution used is governed by the doctor test on the finished distillate. The finished distillate should be sweet to the doctor solution. Another method for testing at this stage is to draw a sample of the oil and treat it with a very small amount of dilute blue solution; if the blue color is decreased in the least treatment is incomplete, and more blue solution must either be used or the throughput of distillate decreased. (Here the author would suggest the placing of another settling tower, for the separation of the copper sulphide and other sludge precipitates because considerable chemical is carried to the storage tanks in this installation described, which could be avoided by use of the extra settling stage.)

The sludge blue solution, mixed with sulphides and gums, is drawn off the bottom of this last tower, No. 5, and is disposed of through the sewer.

It would be practical on a large scale to recover the copper salts as well as the acid from sludges. In this installation, however, the acid is the only chemical that is rectified and recovered for future use.

Results.

The rerun gasoline from the blue solution treated distillate is, in the majority of cases, sweet to the Doctor test, noncorrosive, and of good color, usually from 25 to 30 Saybolt, depending upon the amount of acid used. This color is very staple in sunlight for most gasolines. The quantities of acid and blue solution required for treating various pressure distillates will vary. These amounts are usually predetermined in the laboratory. It has been found that the amount of 60.5 degrees Be acid required varies from two to eight pounds per barrel, while the blue solution required will vary from one to four pounds per barrel. The reaction of blue solution with sour gasoline and distillates is much slower than the action of plumbite solution. For this reason, it will be found beneficial to allow the treated distillate to remain in storage from five to 15 days before rerunning.

Turbo-Mixer Appoints Foreign Representative

TURBO-MIXER CORPORATION, New York, N. Y., have appointed the National Supply Corporation, of that city, to represent them in England, Roumania and the Argentine for all products of their manufacture for the petroleum industry. Western Engineering Company, San Francisco, will represent Turbo-Mixer Corporation in the section of California north of the Tehachapi Mountains for all products of their manufacture.

Tret-O-Lite Successor to Wm. S. Barnickel & Co.

TRETOLITE COMPANY announces that effective December 15, 1930, it became successor to Wm. S. Barnickel & Co., of St. Louis, Mo.

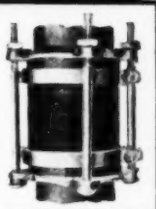
PIPE LINE CLAMP

for repairing long splits in pipe

THIS strong, simple Clamp is designed particularly for repairing long splits and lines that are corroded for six or eight inches. Absolutely permanent.

Made with the Skinner principle of bolts on one side only—a hinge on the other. The nuts are always on top. Made in all standard pipe sizes, from one-inch to six-inch, inclusive.

THE SKINNER *Pipe Line Clamp is particularly valuable during the freeze-ups of the "Norther" season.*


SKINNER COLLAR LEAK CLAMP

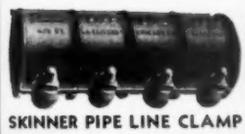
SKINNER PIPE JOINT CLAMP

M. B. SKINNER COMPANY
Sample Street at Falcon Street
SOUTH BEND, INDIANA

SKINNER H. P. SADDLE CLAMP

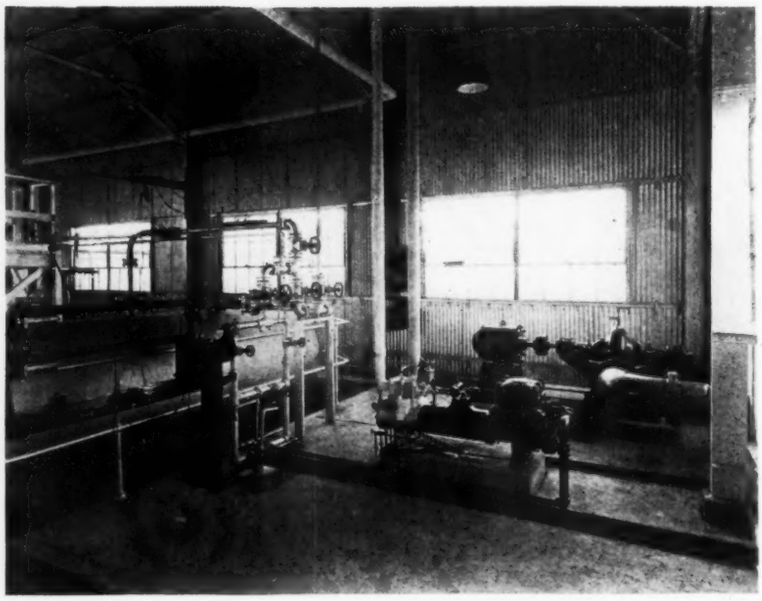
EMERGENCY PIPE CLAMP

SKINNER BAND CLAMP


SKINNER PIPE LINE CLAMP

SKINNER SERVICE SADDLE

SKINNER



Interior of another Ethyl tank car mixing installation, showing tank car of fluid in extreme left background, and fluid storage tank, together with weighing apparatus and eductor, in left foreground with pumps on right.

Tank Car Mixing Installation *for* ETHYL GASOLINE

By J. G. MARTIN, *Ethyl Gasoline Corp.*

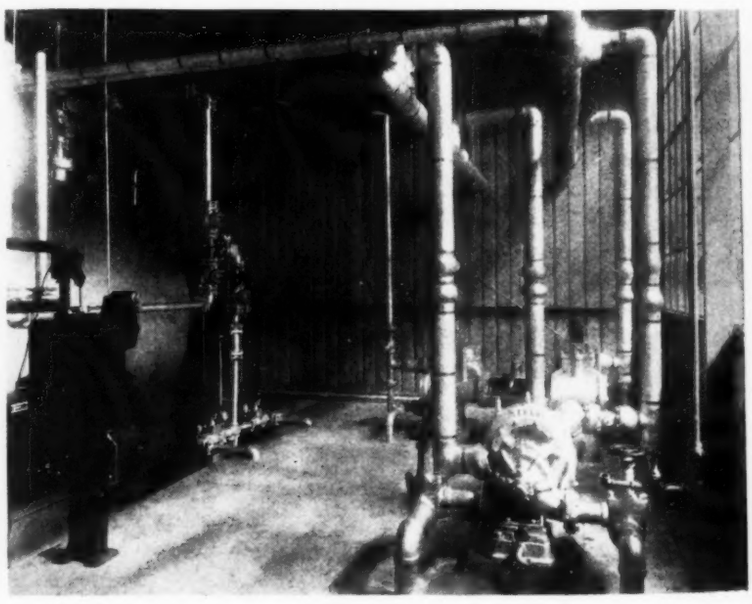
ETHYL GASOLINE was first marketed in February, 1923. With the growth in sale of Ethyl Gasoline there were experienced considerable difficulties in the mixing of Ethyl fluid with gasoline. At the beginning of the marketing of Ethyl Gasoline there was no device on the market which would accurately calibrate the small amount of Ethyl fluid used per gallon to the gasoline.

A small device was developed that was attached to each gasoline pump where it was desired to sell Ethyl Gasoline. With this device it was possible to secure either Ethyl Gasoline or a gasoline that did not contain Ethyl fluid from the same pump. Due to the small amount of Ethyl fluid added to the gasoline (never more than one part of Ethyl fluid to 1,260 parts of gasoline), great difficulty was experienced in securing sufficient accuracy.

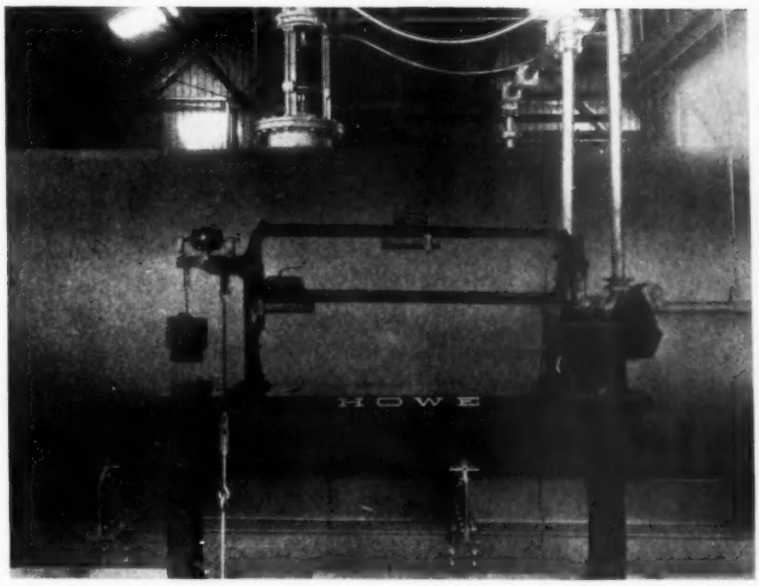
It was soon decided that the Ethyl fluid should be mixed with the gasoline at the bulk station and delivered as a finished product to the pump. This necessitated the use of a larger apparatus and was somewhat more satisfactory than the previous one. With this arrangement Ethyl fluid was delivered to the bulk stations in 10, 25 and 50-gallon drums.

The next step was to design a mixing meter that could be used at the refinery. The Ethyl fluid at the refinery was added to the gasoline as it flowed into the tank car. In this manner the bulk station received its Ethyl fluid as a finished product.

In neither of the previous methods of mixing Ethyl fluid with gasoline was there any opportunity to absolutely control the quality of Ethyl Gasoline that was delivered to the public. It was found that there was a sufficient difference in the anti-knock value of the base stock to make it imperative that each and every mix of Ethyl Gasoline should be tested to get the exact lead requirements. The next step was to design a mixing equipment that would provide for the mixing of a full drum of Ethyl fluid, or multiples thereof, with a tank of gasoline at the refinery. The Ethyl



Extreme left of picture shows weightograph, gauge and end of fluid tank together with eductor; right shows foreground, circulating pump, and background, reciprocating pressure pump.



Close-up of weightograph scale beam, with reading device to the right and fluid storage tank in the background.

fluid was shipped only in 50-gallon drums, and it was necessary to calibrate the gasoline to the Ethyl fluid as there was no accurate way of calibrating part drums of Ethyl fluid.

The sale of Ethyl fluid increased to a point where a full carload of drums of Ethyl fluid were used by a number of refineries each month. Where this amount of Ethyl fluid was used, it was deemed advisable to provide for the shipment of Ethyl fluid in tank cars. A system was designed to transport and handle Ethyl fluid in this manner.

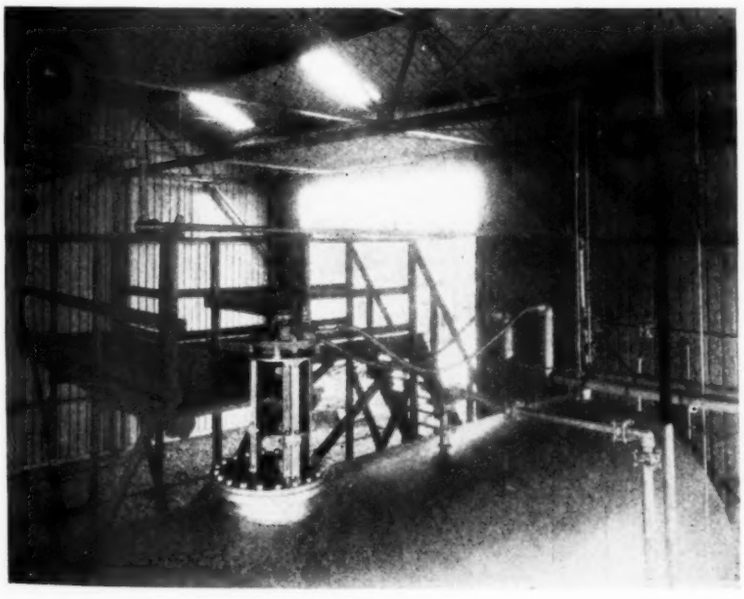
It was decided that the very best tank car available should be used in the transportation of Ethyl fluid. It was necessary to use a tank car that could not be destroyed in any except the most serious wreck that might occur on a railroad. The cost of the fluid and the safety factor cost were to decide on a type of car that has been used in the transportation of anhydrous ammonia, chlorine and other hazardous materials. This type of car is known as class 105-A 300. The only difference in the Ethyl fluid car from this standard type car is that it is not lagged and has a different dome arrangement. The method of handling the Ethyl fluid at the refinery is as follows:

A storage tank for receiving the Ethyl fluid is mounted on a pair of precious metal scales. The car is spotted and connected to the storage tank by proper piping. By the operation of an eductor, vacuum is secured on the storage tank. When the storage tank has been evacuated to a sufficient degree to start flow of the Ethyl fluid from the tank car to the storage tank, the valves on the lines are open. Vacuum is kept on the storage tank until all of the fluid is removed from the tank car. The line going into the storage tank is then closed and the tank car is washed out with gasoline in order to secure all of the Ethyl fluid shipped in the car.

In mixing the Ethyl fluid with gasoline, the weight of the Ethyl fluid is used as a calibration. The scales are equipped with a weightograph which reads to 10 pounds. Without any difficulty whatsoever, the fluid taken from the storage tank can be weighed to five pounds. The gasoline storage tank is arranged with a recirculating pump which has its suction connected to the bottom of the tank and the discharge connection to the top of the tank. When it is desired to make a mix of Ethyl gasoline, the recirculating pump is started. A sufficient quantity of Ethyl fluid is removed from the storage tank by an eductor to give the proper lead content for the particular gasoline. The advantages of the tank car mixing installation are as follows:

1. 20 per cent saving in freight.
2. Less labor required for the unloading of Ethyl fluid from a car and in the mixing operation.
3. No empty drum storage space is required.
4. The exact amount of gasoline in a storage tank can be mixed with the proper amount of Ethyl fluid. In this method of mixing, the Ethyl fluid is calibrated to the gasoline and not the gasoline to the Ethyl fluid.

The 20 per cent saving in freight is due to it being necessary for the refinery to pay freight on the total weight of the package of Ethyl fluid. The drum itself represents approximately 20 per cent of the gross weight of a full drum.



Close-up showing connections to fluid storage tank with connection to tank car running overhead and to the left. The siding on which tank cars of Ethyl fluid are received can be seen in background.

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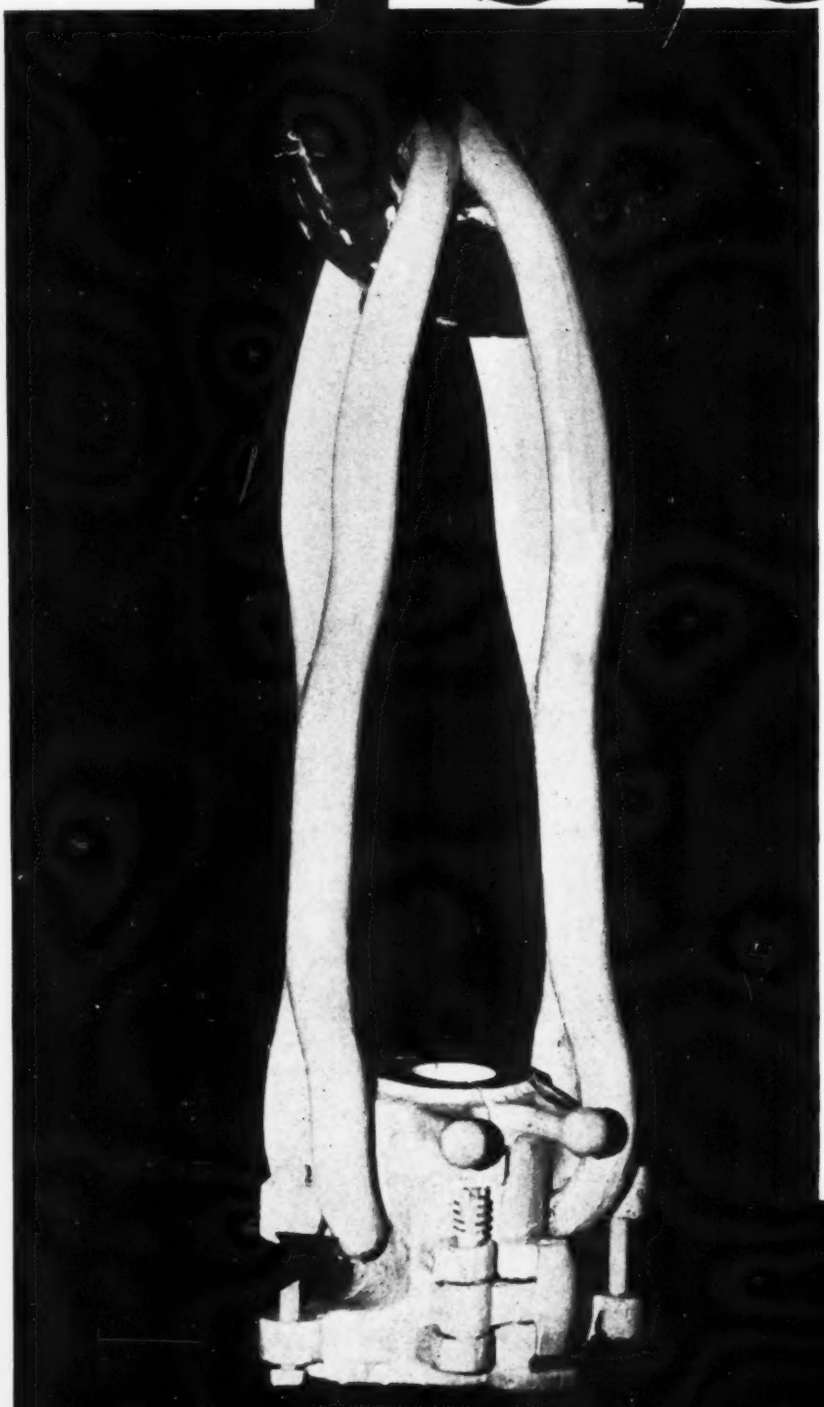

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WELDLESS TUBING LINKS

The Operation of Surge Chambers on Pipe Line Pumps

By **W. R. REED,**
Master Mechanic, Sinclair-Texas Pipe Line Co.

SOME months ago considerable trouble was encountered at a pipe line station in Texas because of the pulsation shocks on the pumps. Parts were being continually broken and the units could not be brought up to capacity. While working to solve the problem Mr. Reed made a rough sketch of the air chamber described in the accompanying article. A short while later the first piston type air chamber was built and when one was installed at the station mentioned it was possible to pump 4,000 barrels daily additional, slippage losses were lowered to 1.4 per cent and the pumps could be speeded up without the former difficulties. One of the accompanying sketches shows graphically the shocks caused by the pump pulsations. It will be noted the upper curve records a 1,000-pound pressure and the story is more graphic when the center curve is considered. It shows the pulsations wave shooting out 900 pounds when the pumps are operating without a surge chamber. When the air chamber was cut in the pulsation curve flattened.

A SURGE chamber is attached in a suitable way with gate valve to the discharge line or discharge manifold of a reciprocating pump, and is for the purpose of absorbing shocks or surges caused from the irregular pump discharge. This shock or surge is much more pronounced where two or more pumps are discharged into the same line or lines and periodically get in syncronism. Starting the surge chamber in operation the gate valve underneath is opened slightly to allow fluid to pass and fill up to the approximate liquid level. The by-pass valve is also opened to allow fluid to pass around the piston. These valves are then closed and the portion above the liquid level is then filled with compressed air or inert gas to approximately the pressure at which the pump is to operate. The surge chamber is now ready for operation and as soon as the pump is started and the pressure up to normal a gate valve can be opened wide and the by-pass valve closed. The shocks or surges are then absorbed by the air cushion above the liquid level instead of being absorbed by the discharge line and various parts of the pump.

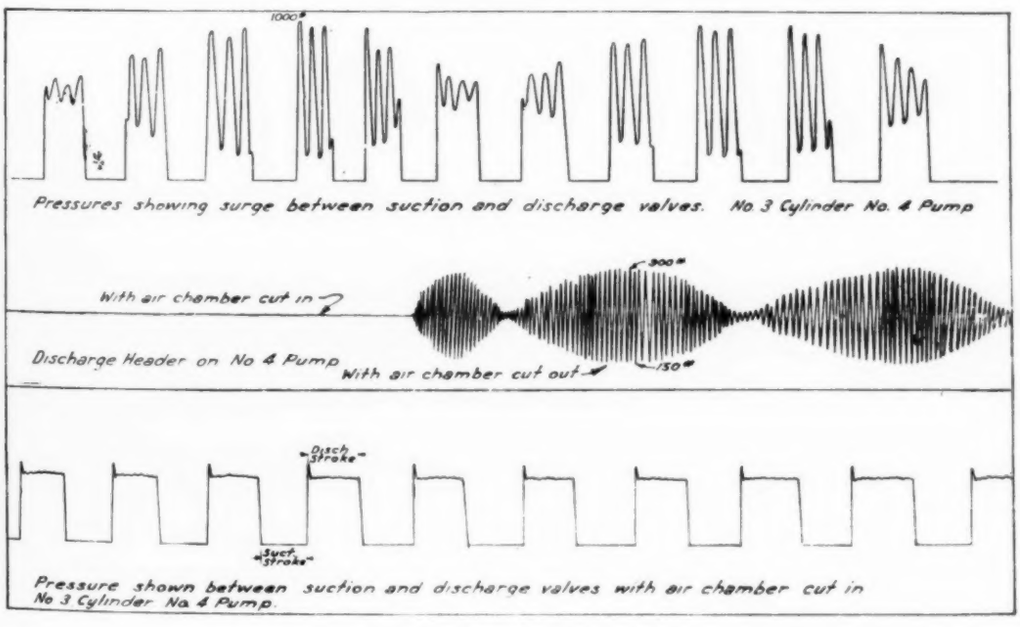
It has been found that the surge pressures sometimes run three times the average line pressure carried, resulting in the breakage of pumps and lines. When the pump is shut down the pressure below the piston is reduced or entirely relieved.

The expansion of the air or inert gas in the top of the chamber above the liquid drives the piston downward, and as the extended, tapered end of the valve starts to enter the opening the liquid below the piston is entrapped and the entire piston assembly comes to a gradual stop with the valve insert resting on valve seat. This entraps all the fluid and air or inert gas above the piston, thus preventing its escape through the opening. The pressure gauge will register a lower pressure due to air above piston having expanded and any leakage by the piston or valve will be indicated by a gradual drop of pressure. The gate valve below the opening can also be closed to doubly insure against the loss of the contents of surge chamber.

In starting up, the gate valve is opened and as soon as the line pressure slightly exceeds the pressure of air entrapped above the piston the small automatic cut-in valve allows the pressure to build up underneath the piston, lifting the entire assembly off the seat. As soon as the valve and dash pot arrangement have sufficiently cleared the seat and opening to allow fluid to pass, the automatic cut-in valve seats, due to the spring tension and discontinues to operate.

The piston assembly continues to be carried upward as the line pressure increases until the air above has been compressed to a pressure approximately equal to the pressure below. Any surges or shocks are then absorbed by the entrapped air.

If the line pressure should be increased above that which was originally carried due to speeding up of pump or pumps, the piston would be carried upward until the air is compressed to equal the line pressure, and if carried high enough


1000#
Pressures showing surge between suction and discharge valves. No 3 Cylinder No. 4 Pump
With air chamber cut in
900#
Discharge Header on No 4 Pump
With air chamber cut out
150#
Disch. Stroke
Suct. Stroke
Pressure shown between suction and discharge valves with air chamber cut in No 3 Cylinder No 4 Pump.

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the dash pot comes in contact with a recess in the spider and the automatic by-pass and relief valve is opened allowing fluid to pass through the parts and on up past the valve into the space above piston. The piston cannot pass beyond the rim of the spider.

The liquid level in this case will then be considerably above the range of the gauge glass as well as the piston being above its normal central position. More air or inert gas is then introduced from the source of supply through one of the valves, and the by-pass valve is opened and the excess fluid above the piston replaced with the desired amount of air and the piston seeks its normal level and operating position suspended there, by the suspension springs. When the chamber is in a normal operating position all valves in the piston assembly remain closed and the piston only acts as a partition pulsating between the solid fluid below and the air or gas impregnated fluid above and thus prevents the loss of air or gas by impregnation of all the fluid within the chamber and the subsequent loss through opening.

The automatic by-pass and relief valve has another function other than above mentioned, in that it also acts as a relief valve. In case the pressure underneath the piston is greatly reduced, causing the piston assembly to seat on the valve seat and if for some reason this valve did not hold and the pressure above and below, the piston did not remain equal by allowing part of the entrapped liquid below the piston to escape, this valve would relieve the pressure above the piston at about the same rate as it was being relieved below due to the leakage, and thus prevent the building up of an unequal pressure over the entire surface of the piston. This piston is of light construction so as to reduce inertia as much as possible and is not intended to stand very great unequal pressures, and the escape of the contents of the chamber is more desirable than possible damage to the parts.

In case the line pressure is reduced, the air in the top of the chamber expands carrying the piston to a lower level and it is then necessary to draw off the required amount of air to bring the level up to its normal operating position.

Where air is used it can be expelled to atmosphere by a valve, or if inert gas is used it can be drawn off into a tank and recompressed to the desired pressure by any suitable means. On account of the very small amount of air or gas lost in operation this chamber is very adaptable to the use of inert gas where very explosive liquids are being pumped.

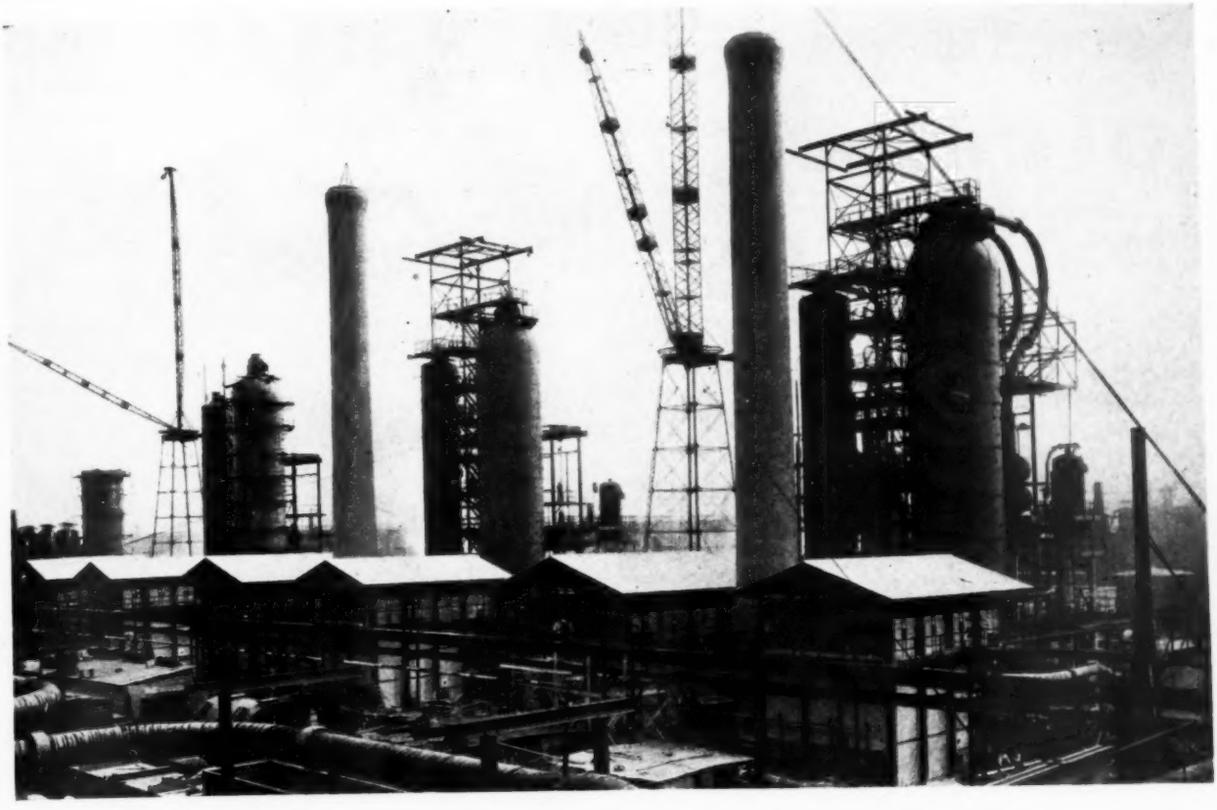
A stand pipe used in the installation is for the purpose of automatically holding the fluid level at the same point in cases where a uniform line pressure is sometimes maintained for weeks or possibly months at a time. A tank of compressed air or inert gas is attached to the charging line, the pressure in this tank being exactly equal to the pressure in the chamber.

As the pulsations occur with the entire body of fluid and piston in motion, a very small amount of the air is lost past the piston or from small leaks too small to be detected.

As the air decreases within the chamber, due to the small leaks, the fluid level rises slightly and a drop or two of fluid will spill over the edge of this stand pipe and go into the auxiliary tank, displacing an equal amount of air into the chamber and this maintains a uniform level until the entire supply of air within the auxiliary tank is exhausted and displaced with fluid.

Jackson Engineering Moves Offices

JACKSON ENGINEERING CORPORATION recently announced the removal of its offices from 801 East Archer Street and 829 McBirney Building to 11 East 5th Avenue, Tulsa, Okla.



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THE MECHANICAL CONSIDERATION *of* PRESSURE CONTROL

By LOUIS H. BRENDEL, *Neilan Co., Ltd.*

MODERN oil industry processes are dependent for their efficiency upon improved methods of pressure control. With each new process development, have come higher pressures and more exacting demands for maintaining these pressures unvaryingly. The efficiency with which the various types of pressure controllers function is due to the mechanical excellence of their design and materials. These designs and reason for them as seen in some popular types of pressure regulators will be investigated in these notes.

Basically all pressure regulators are divided into two general classifications, namely, those in which increased pressure opens the valve, Fig. 1, and those wherein a rising pressure closes the valve, Fig. 2. These are respectively designated as back-pressure regulators or relief valves and reducing regulators.

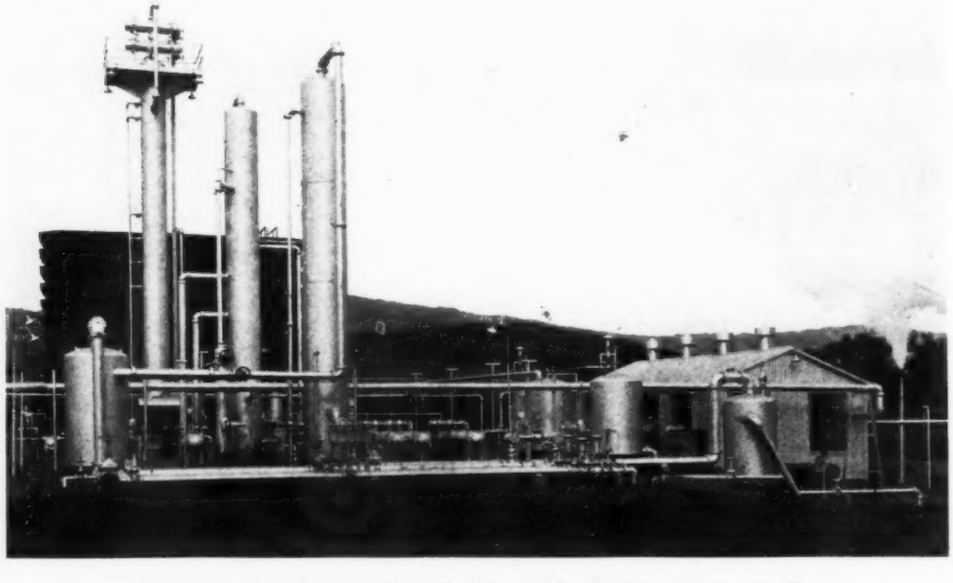
The simplest form of regulator in both of these classifications is the "direct-acting" type. By this is meant a valve, the stem of which is firmly attached to a flexible diaphragm. The pressure to be controlled is piped in so as to exert its force on one side of the diaphragm with a variable resistance to this pressure on the opposite side. Practical methods of loading diaphragms in use at present are as follows:

1. Those utilizing the force of gravity to oppose the controlled pressure.
   a. The simplest example of this type are those making use of a "dead weight" consisting of metal weights piled on top of the diaphragm. A variation of this are those regulators in which the weight of a column of mercury opposes the pressure against the other side of the diaphragm.
   b. In order to control higher pressures without excessive bulks of metal, the power of these weights is frequently multiplied by employing a lever and fulcrum.
2. Regulators which make use of springs to oppose the pressure force on the diaphragm. This type of pressure controller is divided into two divisions:
   a. Regulators utilizing a single spring to furnish an opposing force to the controlled pressure.
   b. Those which employ a nest of multiple springs to supply this resistance.

The evolution of multiple springs in place of a single spring in pressure regulators was the inevitable result of the demands of plant engineers for closer regulation. Closer regulation could be obtained only by increasing the diaphragm sizes. This would permit smaller variations in the controlled pressure to act over a larger area and produce the same operating power for the valve.

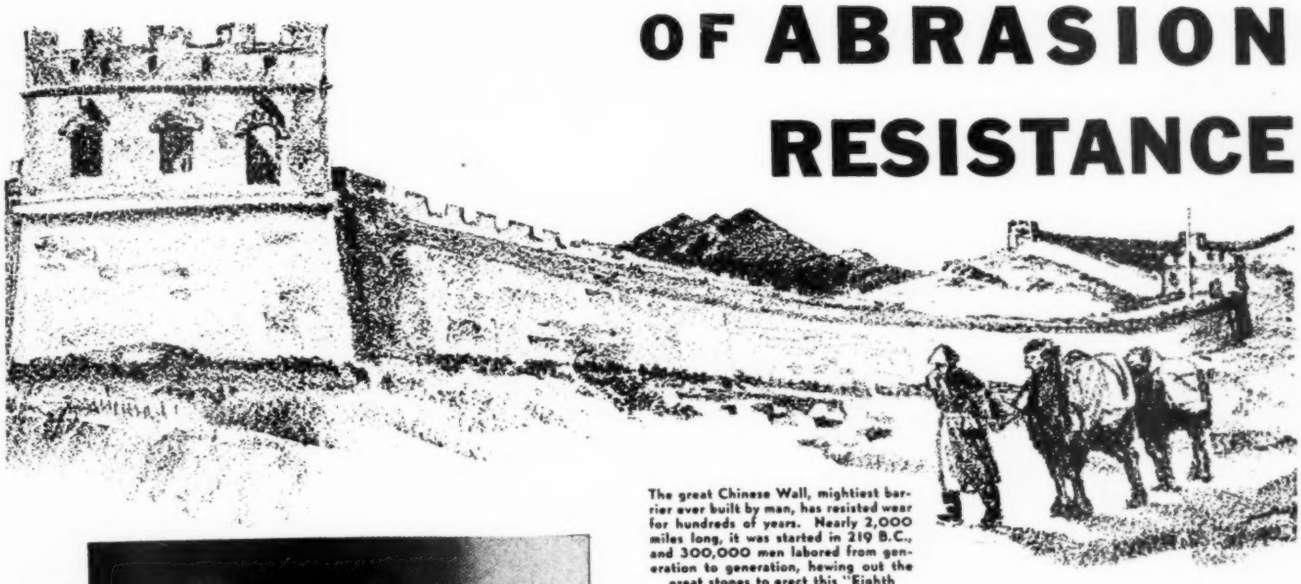
A larger, longer, single spring might have been used to oppose these desired increased diaphragm sizes. This would have, however, increased the size, weight and cost of the regulators beyond practical and economic limits. Careful studies of the laws and characteristics of springs disclosed that by nesting several springs one within the other that the load these springs would support was far greater than any single spring other than the impractically oversize spring just mentioned above. This solved the problem of larger diaphragms and closer regulation with but a trifling additional weight and cost.

From Hooke's Law we note a characteristic of all springs, namely, that their deflection is proportional to the force applied. Due to the fact that sensitivity in a regulator is dependent upon a small change in pressure on the diaphragm producing as great valve movement as possible, thus was the single spring of reasonable length and diameter auto-



Natural gasoline plant near Santa Barbara, Calif., showing pressure controllers.

A SOLID WALL OF ABRASION RESISTANCE



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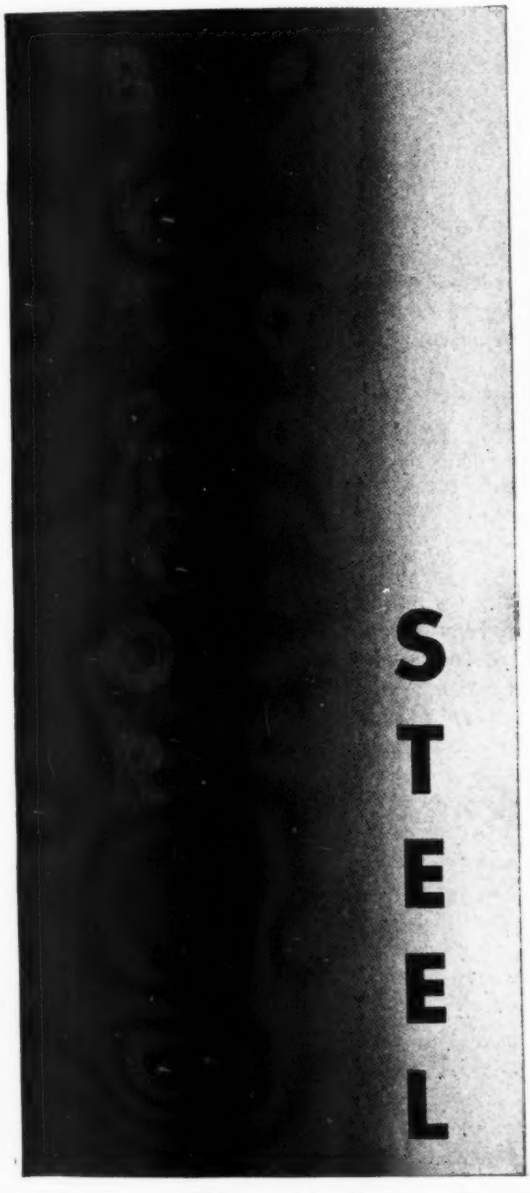

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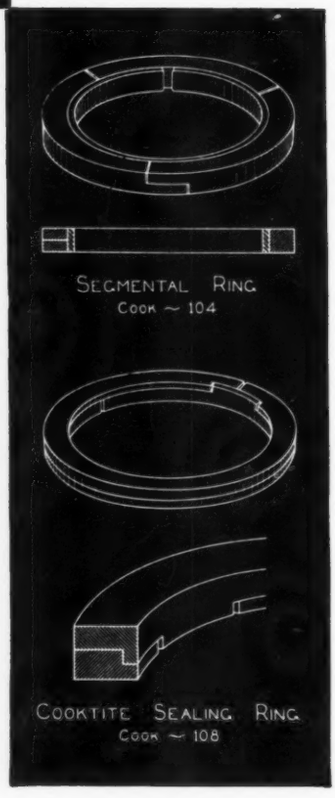

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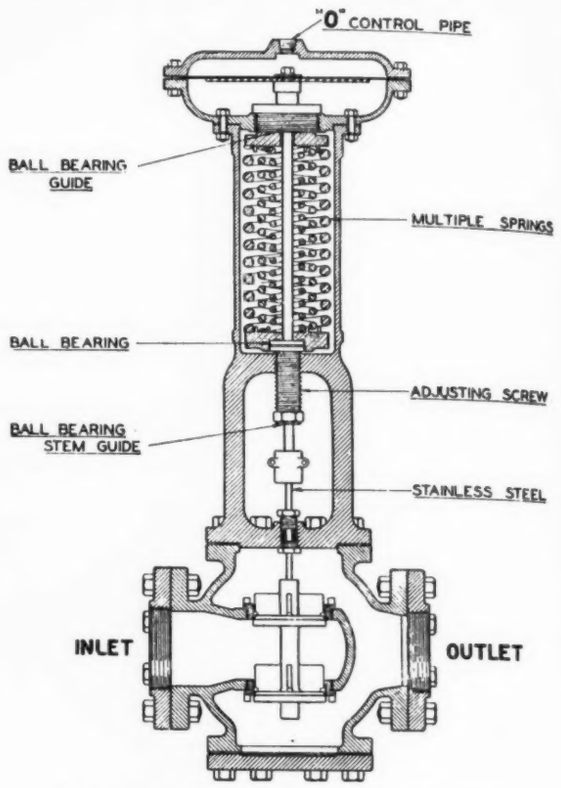

Fig. 1. Back pressure regulator (direct acting type).

matically relegated to the discard except for services not requiring the sensitiveness that many conditions demand. From the laws governing coils of springs it is seen that by increasing the diameter and length permits increasing the number of coils which provides greater flexibility. Furthermore, if the load is lightened on any coil spring then the wire size may be reduced which again permits a larger number of coils in a given length, which still further increases the flexibility. This is accomplished by nesting several springs concentrically, one within the other. A relation of spring diameter to spring length must be determined upon, too, so that the maximum flexibility is obtained. The greatest possible range of compression is desirable in a spring of given length. It is also advantageous to use as small diameter spring wire as is possible and stress the spring completely to its safe limit so as to derive the maximum flexibility. It must be borne in mind, at the same time, that the flexibility of a spring decreases rapidly when stressed too near its elastic limit. The length of the adjustment necessary to make a set of springs take a given load is the key to their deflection. In computing spring sizes it is desirable to pick a combination which will require as much compression to support its working load as is possible within economic design limits.

Probably the greatest single obstacle to overcome in the design and construction of any pressure regulator is friction. It is the enemy that clutches at each moving part and diminishes the sensitivity of all pressure regulators in varying degrees. In this respect it is interesting to observe how the heavier loading made possible by multiple springs is reducing the effect of friction in regulators. For example, consider a regulator using weights to deliver a force of 500 pounds to the diaphragm. Suppose it has an irreducible friction of 10 pounds which in percentage is 2 per cent. Through the use of a nest of springs the diaphragm of a

similar regulator may be loaded to 1,000 pounds. It now becomes noticeable that the same 10 pounds of inherent friction is only 1 per cent. This then has provided a way of greatly reducing the effective result of inherent friction.

Of course, friction is being combatted by makers of control equipment through the use of stainless steels. By making certain parts of this nickel-chrome alloy, corrosion and its resultant friction have been eliminated. The results of this are most noticeable where valve stems slide back and forth through stuffing boxes. In this respect, stuffing boxes have also come in for their share of recent improvement which includes among other things reduced diameter valve stems. This offers a smaller frictional area where the stem passes through the packing. To provide tight stuffing boxes with the new higher pressures and elevated temperatures, regulators are now being made with stems that rotate in the stuffing box instead of slide. This enables the stems to be packed tightly even under these difficult conditions and eliminates the fire hazard present with leaky stuffing boxes.

One of the most positive means of reducing the deleterious effect of friction has been the judicious use of ball bearings. Regulator valve stems, adjusting screws and numerous other moving parts roll freely on frictionless ball bearings. A recent refinement in this direction has been the use of stainless steel ball bearings and ball races. This feature is of vital importance throughout the oil industry because of the ubiquitous presence of corrosive sulphur compounds. Stainless steel ball bearings are also proving to be of incalculable value in liquid level controllers for all gasoline plant and refinery services.

The subject of friction can hardly be passed by without some mention being made of the use of grease seals on regulators similar to those used on lubricated plug cocks.

Any discussion of the mechanical side of pressure regu-

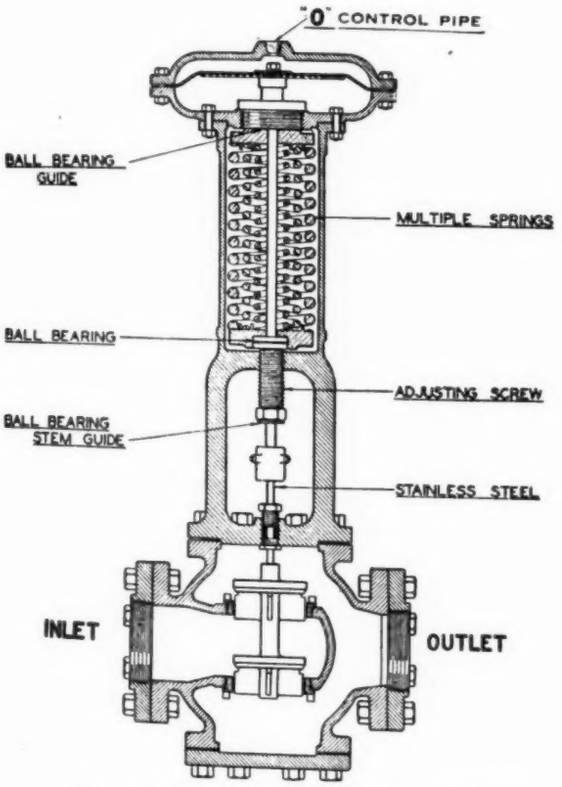

Fig. 2. Reducing regulator (direct acting type).

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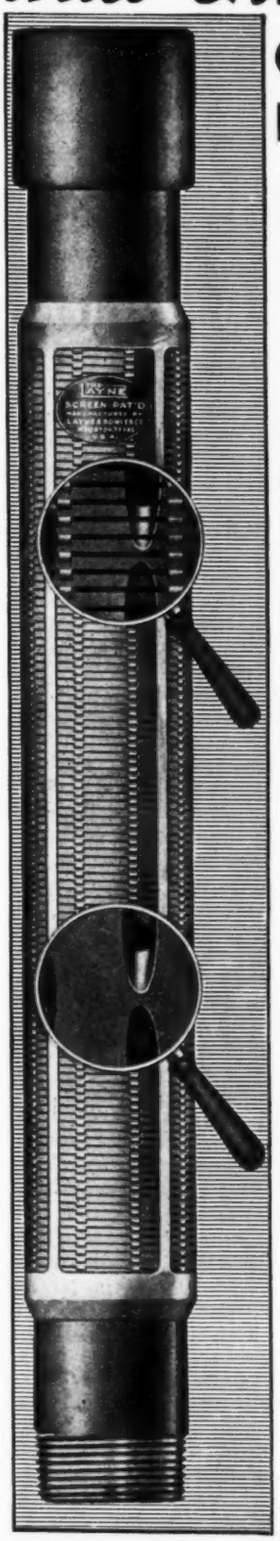

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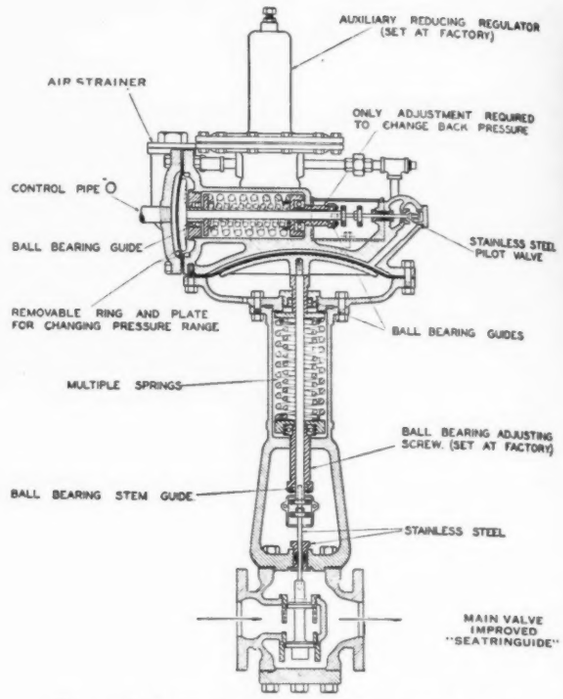
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CONTROL PIPE
BALL BEARING GUIDE
STAINLESS STEEL PILOT VALVE
REMOVABLE RING AND PLATE FOR CHANGING PRESSURE RANGE
BALL BEARING GUIDES
MULTIPLE SPRINGS
BALL BEARING ADJUSTING SCREW. (SET AT FACTORY)
BALL BEARING STEM GUIDE
STAINLESS STEEL
MAIN VALVE IMPROVED "SEATRINGUIDE"

Fig. 3. Back pressure regulator (pilot operated type).

lating devices begins logically with the valve body. This valve body with minor alterations remains the keystone of all pressure regulators. The difference lies largely in the method employed to operate the valve plug in this valve body. Regulator bodies are commonly of the globe valve pattern with the double ported or balanced valve plug. Valve bodies are very much standardized in design. The main thing of importance in the choice of a body is to make sure it has ample clearance through its passages. This will permit pressures to flow through the valve with a minimum pressure drop.

Probably the greatest single cause of trouble with pressure regulators is the material chosen for the valve seat rings and the valve plug. This is commonly referred to as the "trim" of the regulator. These parts are made of a wide variety of substances, the most common of which are cast iron, bronze, Monel metal, KA2 stainless steel, Nitralloy, bakelite and special alloys.

In the design of the valve plugs we find two general classifications, namely, "quick-opening" and "gradual-opening". The former is by far the most common in regulators although there is a growing demand for gradual-opening valves wherever close throttling is desired. The flow curve of gradual-opening valves is parabolic in shape when valve lift is plotted vertically and flow horizontally. Gradual-opening valves find their greatest application in services where the volume being flowed varies greatly from time to time.

The rapidly changing plant processes has brought another factor into primary importance. This is the ability to convert economically, regulators of one pressure range into other pressure ranges. This is accomplished through making it easy to remove one set of springs and substitute another set and to use a diaphragm of a different effective area. Ingenuity has been displayed by progressive regulator designers who make it possible to convert reducing regulators into back-pressure regulators by simply inverting the valve body and valve plug. In certain pilot-operated regulators this quality has been advanced to the point where it is necessary to change only the pilot valve diaphragm ring and

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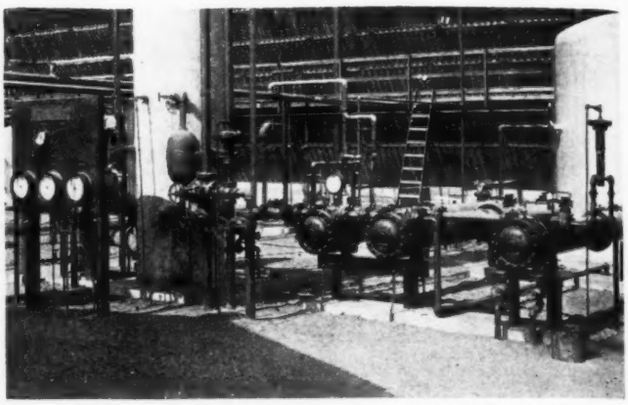
diaphragm plate to obtain any pressure range required without the altering of any springs or diaphragms. These same regulators make it possible to convert a reducing regulator into a back-pressure regulator by merely substituting a pilot valve plug that seats in the opposite direction. It will be appreciated how this flexibility in pressure regulators is eliminating the necessity of buying new regulators with each change in operating conditions.

As in the automobile industry each new regulator model becomes more foolproof. Tampering by unauthorized persons is minimized by enclosing adjusting screws and other moving parts so that they do not invite attention. As will be readily seen this is much easier accomplished in the newer spring-loaded regulators than in the weight and lever type. For the same reason it becomes less of a task to pack these simplified regulators with straw as is frequently done in extreme weather to prevent freezing.



Pressure controllers on stabilizer unit in the Playa Del Rey field of California.

Two characteristics which must be considered in the construction of pressure regulators for the oil industry are ruggedness and compactness. Any amplification of these qualities is unnecessary to readers who are familiar with oil industry conditions. Everyone has seen thoughtless truck drivers toss regulators to the ground at a plant site. Needless to say this requires a sturdy design with parts carefully aligned and rigidly fastened one to another. It is also of importance that regulators be so designed that they are one compact unit. This precludes the possibility of certain important auxiliaries being lost while the device is being moved from one location to another.

As has been previously stated in Hooke's Law, the deflection of all springs is proportional to the force applied. This places definite limitations upon the sensitiveness of direct-acting regulators. For example, a 4-inch regulator of this type requires a valve travel of approximately one inch to enable the regulator to pass the full 4-inch pipe capacity. To illustrate a point, suppose a change of one pound acting on the diaphragm area produces a spring deflection of ⅛ inch which in turn opens or closes the valve plug the same amount. Therefore it becomes plain that in order to open or close the valve the full amount to handle pipe capacity requires 8 x ⅛ inch or a change of 8 pounds on the diaphragm. This means that in certain applications, where large volumes must be passed, that regulation closer than from 4 to 6 pounds cannot be accomplished with a direct-loaded regulator.

Since closer limits of pressure control are imperative in many cases, the pilot-operated type of regulator was de-

veloped, Fig. 3. In this type of regulator the ordinary direct-loaded regulator is augmented with a pilot valve. The pressure which is being controlled acts against the pilot valve diaphragm, moving the pilot valve in such a manner as to supply an operating medium to the main valve diaphragm. Thus with any sustained small increase in pressure, sufficient operating medium is supplied to open or close the main valve completely. It is not uncommon to maintain exactly pressures to within a fraction of a pound variation. This operating medium is frequently supplied from an external source rather than from the line pressure. This makes such a pilot-operated regulator ideally suited for controlling pressures on hot oils and other liquids which would be unsuitable for operating the pilot valve. Because of the relatively small movement necessary in the pilot valve in comparison with the main valve this type of regulator is a necessity for satisfactory regulation at elevated pressures. As is apparent the higher pressures demand stiffer springs and smaller diaphragms, both of which provide insufficient travel for the main valve but ample for the pilot valve.

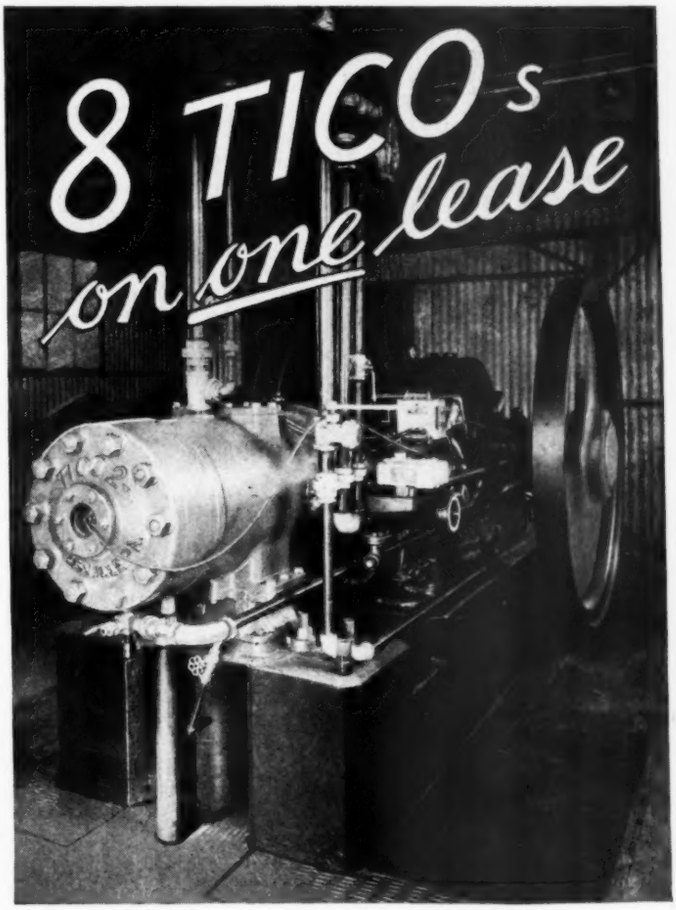
In the mechanical construction and design of pilot valves the same general principles apply as we have observed in direct-loaded regulators.

Another fundamental consideration in the fabrication of a pressure regulator is the diaphragm material. The use of a rubberized fabric is almost universal for this purpose. Certain conditions make it necessary to use a metal diaphragm in order to resist the destructive action of the fluid being controlled. A part of what is gained in resistance to this deterioration is sacrificed in reduced length of life due to the fact that metal diaphragms crystallize and break much more quickly than rubber. Furthermore they lack the flexibility necessary for larger valve movements. Rubberized fabric diaphragms commonly used are 1-ply, 2-ply and 3-ply in thickness depending upon the pressure they must support. This diaphragm is covered with a special oil-resisting sheet for service where destructive oil or gasoline vapors are present. Seals are regularly used to protect these diaphragms in steam and hot oil service. These seals are of water or cool liquid of the kind that is being controlled and protect the diaphragms satisfactorily against deterioration by heat. Leather has been used to some extent for diaphragms, but has the disadvantage of drying out in a short time and becoming stiff which interferes with the sensitivity of the regulator.

Let us inspect closer the effect of diaphragm sizes in pressure regulators. Naturally, the size of diaphragm that may be used on any regulator is governed by two conditions. These are the physical strength of the diaphragm sheet and the practical economic size limit in extremely low pressure regulators. Furthermore, as the flexibility of any spring or group of springs depend upon the load which they must support, increased diaphragm sizes will, as a result, require less flexible springs to support these increased total pressures of the larger diaphragm areas.

Through the use of larger diaphragms the inherent friction, the inertia of the moving parts and the effect of velocity head upon the valve plug are all reduced to a much smaller percentage. Thus if we subtract this destructive frictional force from the greater total pressure of the larger area, a larger net effective force remains to operate the valve plug. This insures more positive operation and the same valve movement with a smaller controlled pressure change acting over the larger diaphragm surface.

In these notes we have investigated a few of the mechanical considerations that must be observed in the design of pressure regulators. In our next article it shall be our pleasure to analyze the particular pressure control problems which are present in the modern gasoline plant and see how they are being conquered.



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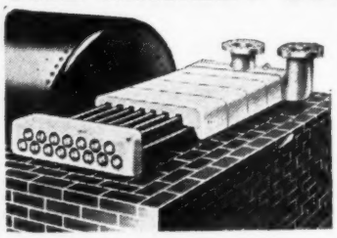

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Water Well Is Tested With Portable Electric Motor

UPON the completion recently of a water well for the Barnsdall Oil Company at its refinery at Okmulgee, Okla., the Shuler Company, water well contractors of Oklahoma City, used an electric motor for making the preliminary test of the well's volume.

It is a general practice in the Mid-Continent to test water wells before installing permanent equipment. This is done to determine the commercial status of the well and to enable the purchasers to install the proper size equipment.

In this case a small electric motor was set on an ordinary motor truck bed and was transported to the site of the well. A line was attached to the motor from a nearby power line. The motor then transferred its power to the pump by means of a belt, as shown in the picture.

The well is 47 feet deep and is producing 250 gallons of water per minute.

Tractors and other machinery are often used in this method on turbine type pumps, but the Shuler company is one of the few using a portable electric motor unit for the preliminary test.

Death of F. A. Pielsticker

F. A. PIELSTICKER, vice-president in charge of the refining division of the Skelly Oil Company, died January 13th at Redlands, Cal. Mr. Pielsticker had been in ill health for several months and was undergoing treatment in a Redlands sanitarium at the time of his death.

When the Skelly Oil Company was organized in 1919 he became associated with the company as vice-president in charge of refining, a position he held until the time of his death. Previously he had been connected with W. G. Skelly in the Midland Refining Company and Inland Oil Company.

F. A. Pielsticker

Mr. Pielsticker graduated from the Iowa State Agricultural College at Ames in 1904 with the degree of B. S. in engineering.

He is survived by his widow and two sons, William and Robert, and a daughter, Louise.

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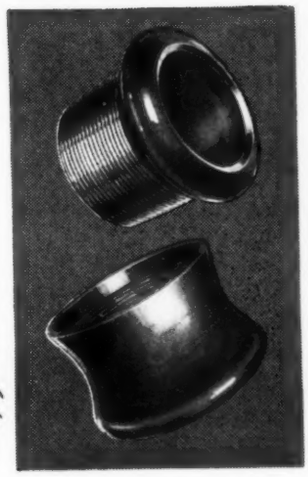

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If you have such photographs, we shall appreciate your permitting us to reproduce them in our pictorial section. Extreme care will be exercised in handling them and they will be returned in the same condition as received. Kindly address photographs to

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Wico Electric Company Broadens Service

A NUMBER of years ago the Wico Electric Company, manufacturers of WICO magnetos, established a direct factory branch in Tulsa, Oklahoma, located at 115 West 8th Street. Leon F. Smith, the manager, spends the majority of his time in the field. His work in the field has been so helpful to many companies that Wico early this year increased the scope of its field service by the placing of Robert (Bob) Phillips in the Seminole, his address being in care of the National Supply Co., Seminole, Oklahoma. Phillips covers this district, helping the operators there to get the maximum service out of their Wico magnetos. On October 1st the company placed Glenn Hendrickson in Texas with headquarters in care of Generator Service Company, 1151 Commerce Street, Fort Worth, Texas. He will cover regularly the Texas field. Any oil company or operator desiring the assistance or service of these men has but to call on them at the addresses above given, or by directing a letter to the Wico Electric Company at Tulsa, Oklahoma.

Robert Phillips

Glenn Hendrickson

Wico operates a large service branch in Tulsa, where a corps of factory trained men are in constant attendance. Wico users have found the Tulsa branch a great aid because machines repaired there are fitted with genuine parts and every job is guaranteed the same as a new machine. The danger of the use of spurious parts and make-shift repairs by inexperienced people is eliminated. Both Bob Phillips and Glenn Hendrickson will be prepared to pick up WICOs at all points and give quick service on them.

Westcott & Greis, Inc., Distributors for Oceco

WESTCOTT & GREIS, INC., Tulsa, Okla., announce the taking over of sales and service on all products of The Oil Conservation Engineering Company in the territory formerly covered by the Oceco Tulsa office and in California. None of the equipment manufactured by either company will be taken off the market.

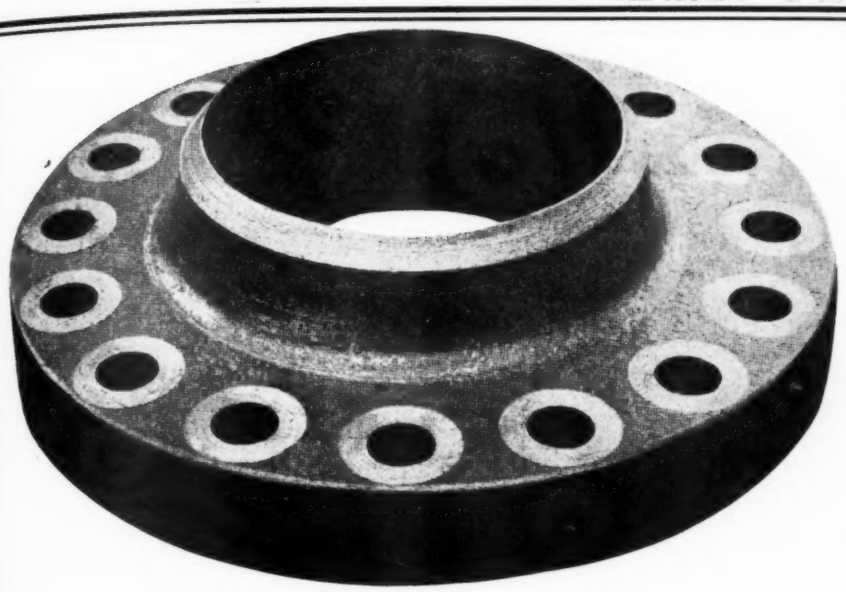
Oklahoma Contracting Changes Name

TOM JONES, president of the Oklahoma Contracting Company, announces a change in the firm name effective January 1st, 1931. In the future, this firm will be known as the Oklahoma Contracting Corporation.

The Oklahoma Contracting Company has been actively identified with pipe line activities throughout the South and Middle-West for a number of years. They recently completed the Ajax Double 10-inch pipe line, and are at present laying pipe on the Panhandle-Eastern 24-inch line. Offices of this concern are at Dallas and Tulsa.

Correction

IN THE rotogravure section of The Petroleum Engineer for December, 1930, the photographs of George T. Horton, president, and Merle J. Trees, vice-president, of the Chicago Bridge & Iron Works, appeared. Unfortunately, the caption was incorrect, and Mr. Horton's picture was on the left and Mr. Trees on the right, instead of the manner in which the captions indicated their identity.



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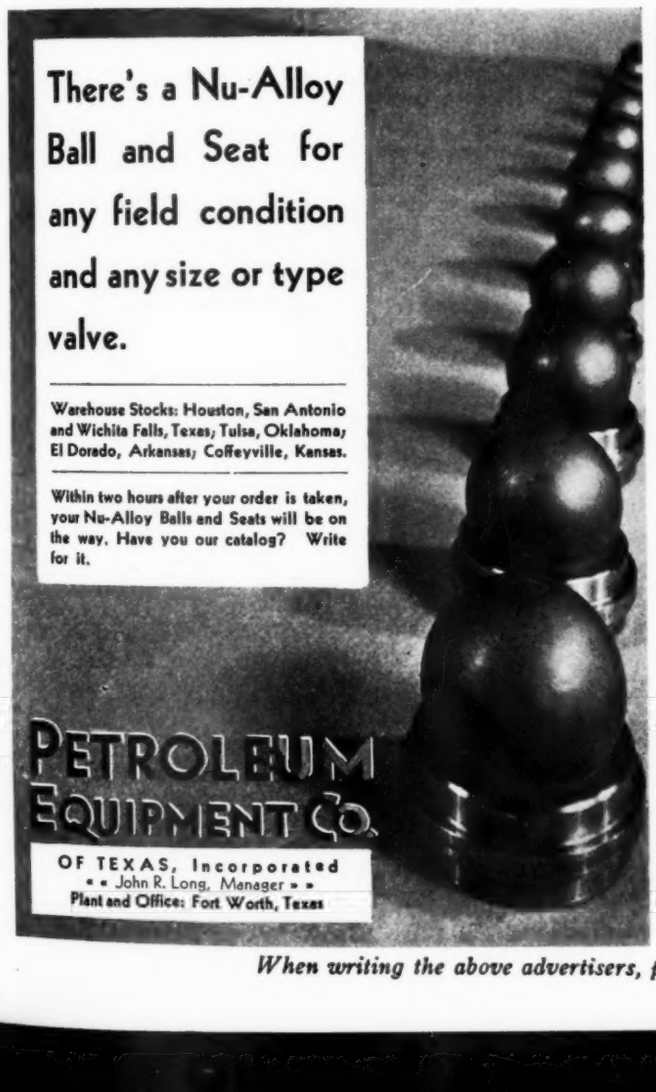
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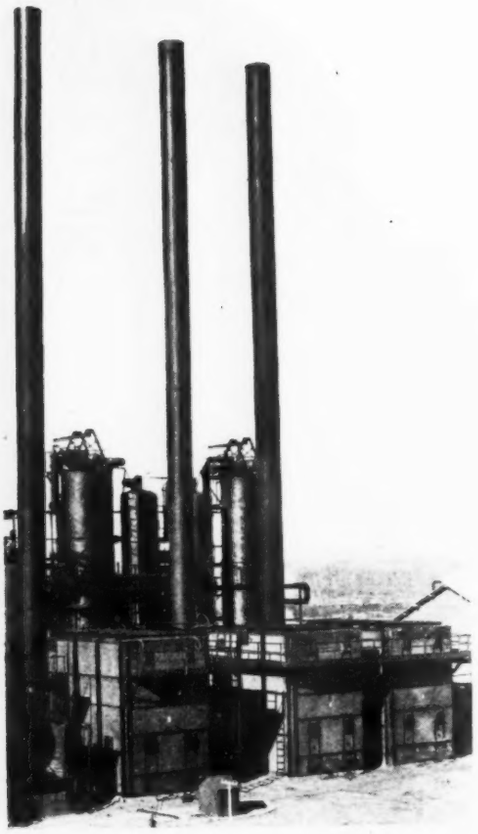


Above—Pipe stills in the Barnsdall refinery at Okmulgee, Okla. Below—A drawing of the world's first refinery.

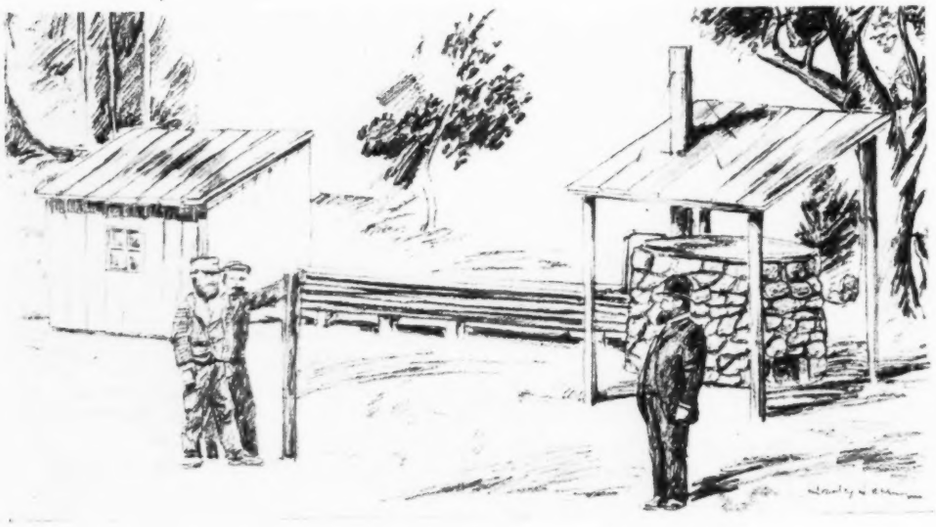
LIKE many of our great modern manufacturing industries, that of petroleum refining started in a very simple plant. Although the first refinery was built about seventy years ago, the greatest progress has been made during the last 15 years. Our large continuous refining units of today, automatically controlled and continuously operated, are contingent upon the great progress made in engineering, metallurgy, physics and chemistry. Through the co-operation of refinery technologists with aviation and automotive engineers, the refiner has always met the new demands for higher quality fuels and lubricants created by the rapid developments in the manufacture of internal combustion engines.

The industry's first oil refinery was built in 1860 in Oil Creek, Pa., by William Barnsdall and William H. Abbott. This plant, when compared with the present-day refinery, was very simple and crude. It was essentially a closed iron kettle with an overhead pipe for vapors. This was elevated several feet above the ground and a cylindrical wall of stone formed the furnace. The still had a charging capacity of only a few barrels, and was naturally batch operated. Although this appears to be a very elementary undertaking in the light of present-day knowledge, it was no doubt considered quite a feat then. At the time, burning oil, or kerosene, was the most important petroleum product. Of course, there was no gasoline market, and the lighter fractions from the crude oil were usually wasted entirely. For about 40 years kerosene was the most important product until its use was curtailed by electric lighting and the development of the automobile created an enormous demand for gasoline.

Today the Barnsdall Refining Co. operates three refineries equipped with the most modern equipment for the manufacture of the highest quality lubricants and motor fuels. The marvelous progress in the various fields of engineering and the eagerness with which the petroleum industry has taken advantage of these developments are apparent when one studies a modern refinery.

The Barnsdall refinery at Okmulgee is essentially a gasoline manufacturing plant. It produces various grades of motor fuel, including Barnsdall Ethyl Gasoline. The plant has a daily crude capacity of 10,000 barrels. Seminole and Bristow crudes are processed. The oil is delivered to the plant in pipe lines.

The Cross combination reducing and cracking unit recently completed at this refinery is the first of its kind to be built in the United States. It is essentially a Cross cracking unit together with a pipe still. The units can be run separately as a pipe still or a cracking unit, or in combination. The total daily charging capacity is 1,500 barrels of gas-oil, or 2,400 barrels of reduced crude. The products are anti-knock gasoline and liquid coke or asphalt.



The first still is operated under atmospheric pressure and the second one, as a part of the cracking unit, operates under pressure up to 700 pounds. The crude oil is first topped in the crude pipe still, which takes off about 40 per cent of straight-run gasoline, kerosene and some gas-oil. When reduced crude is charged to the new unit, the operation is as follows: The oil is pumped through heat exchangers to the first pipe still, where it is heated to

in Petroleum Refining

By
F. R. STALEY

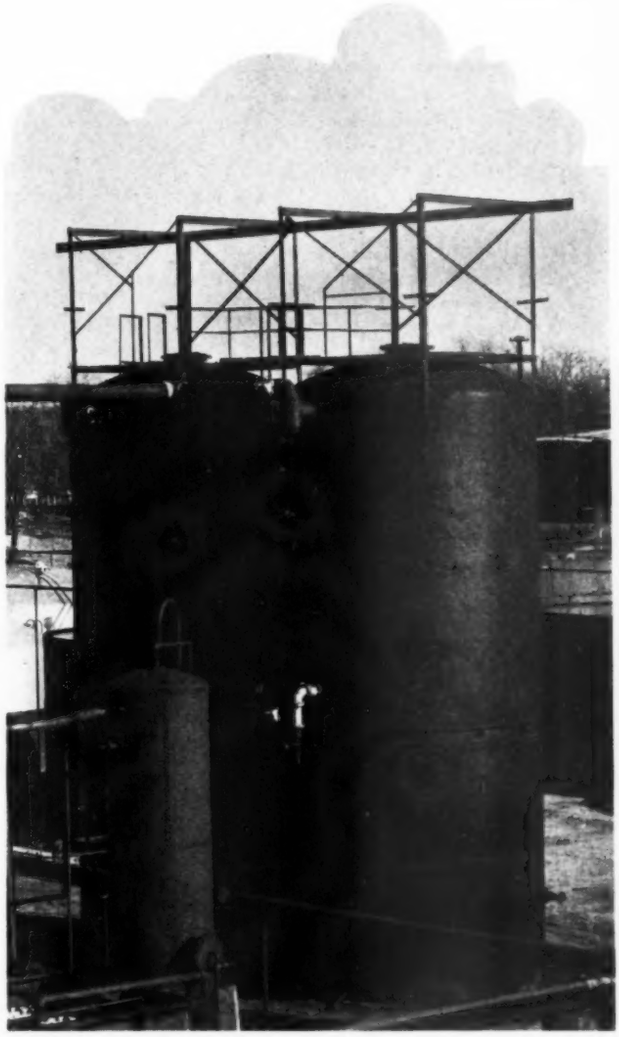
approximately 800 degrees. From here it enters the evaporator, where the light fractions pass over into the fractionating tower. The hot oil from the bottom of this tower is charged to the pressure pipe still, where it is heated to about 900 degrees F. and then enters the reaction chambers. From here it passes to the same evaporator that the hot oil from the first pipe still enters. In other words, the hot oil from the two pipe stills comes together in the evaporator. The hot tar from the evaporator is transferred to a specially designed vacuum tower, which strips it of all intermediate matter, producing a very heavy asphalt or liquid coke. The gasoline of the desired end point is taken off the fractionating tower in the vapor phase and passes into the Gray towers.

The intermediate material vaporized in the vacuum tower can be marketed as a domestic burner oil. The heavy asphalt would solidify immediately on cooling, consequently it is pumped (high vacuum pump used) under high pressure to especially designed burners, at a temperature above 700 degrees, where it is fired to the stills.

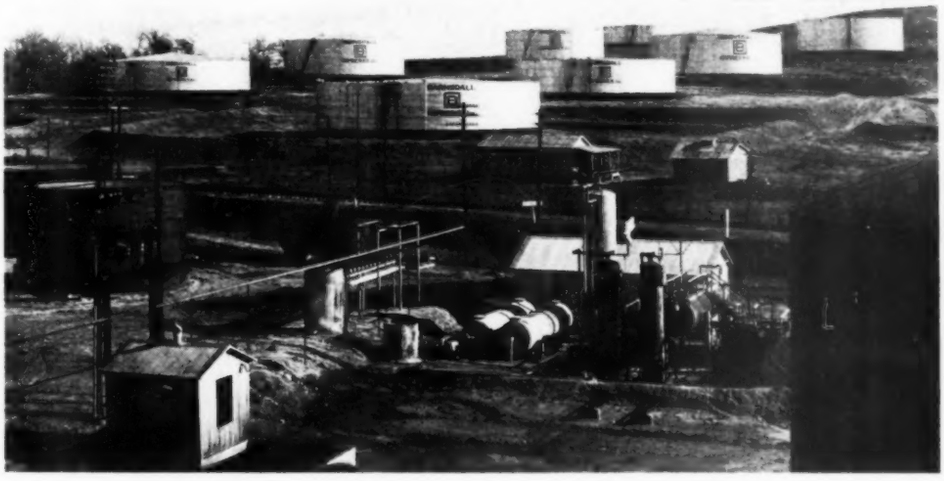
All of the gasoline from the unit is refined in the vapor phase by means of Gray towers. This installation consists of two of the largest towers in existence, each having a capacity of 45 tons of clay. A 60-90 mesh clay is used in these towers. The yield is from 10 to 12,000 barrels per ton of clay. The gasoline from the towers is taken to the continuous treating plant where it is sweetened with sodium plumbite solution. Polymer traps are installed on the towers. The polymers are run into charging stock.

In addition to the new double furnace installation, a 1,000-barrel Cross unit is operated in the refinery. This is operated independently of the new unit. Gas-oil is used as the charging stock. Hot oil recirculating pumps of the turbine type are used.

The operation of the boiler house is practically entirely automatic. The installation includes five 268-H. P. water tubular boilers. Automatic pressure and water level controls are used. Boiler feed water is obtained from wells and requires no chemical treatment. The boilers are fired with tail gas from the recovery plant. The furnaces on the boilers have air-cooled walls, which pre-heats the air for combustion. Radiation losses are minimized, and it is even necessary to heat the boiler house in winter time. The boilers operate under 135 pounds line pressure.



Above—The largest Gray towers are shown here. They are at the Barnsdall Okmulgee plant.
Below—Treating plant and tank farm at one of the Barnsdall refineries.



Barnsdall Ethyl gasoline is produced at this refinery. The gasoline produced on the cracking units possesses such a high anti-knock rating that only a minimum quantity of Ethyl fluid is used, as required by the Ethyl Gasoline Corp.

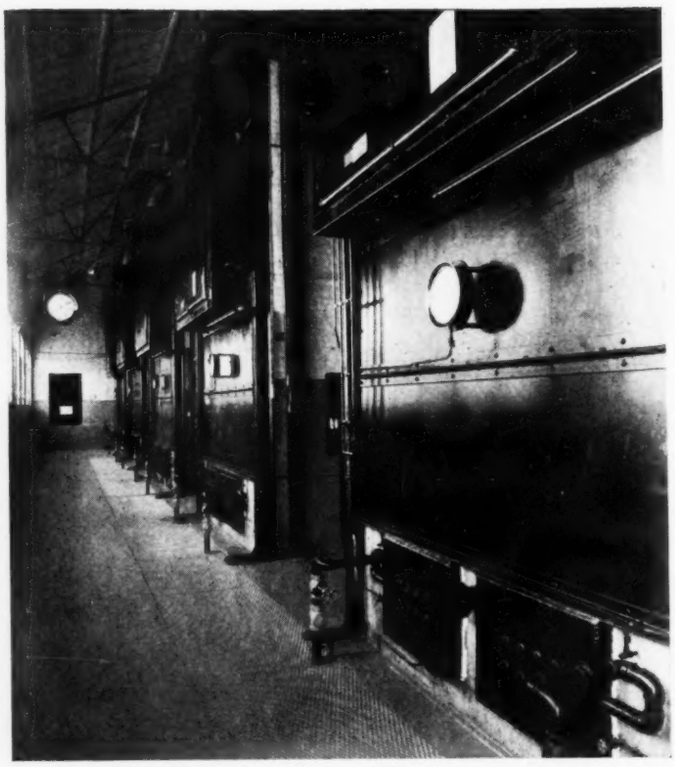
A modern gasoline recovery plant was completed recently to recover the vapors from the cracking units and the crude stills. This consists of a compression type plant and a stabilizer for stabilizing

the raw gasoline. The unit is operated under 300 pounds pressure.

The refinery at Barnsdall, Okla., has a capacity of 5,000 barrels of crude per day. Only selected crudes from the Osage field are run. Completely dewaxed motor oils and bright stocks are manufactured here. All of these products are double filtered and consequently show a minimum carbon residue and very good demulsibility test.

The crude oil is run continuously in a pipe still and fractionated into straight-run gasoline, kerosene, and gas-oil. The long residiuum is then further processed for lubricants.

The gas-oil is cracked in Cross units. There are three of these units in the refinery: one 1,000-barrel unit and two 500-barrel units. All of the cracked gasoline is treated in the vapor phase in Gray towers. Three six-ton towers treat the products from the two smaller units, and two 16-ton towers are installed with the 1,000-barrel unit. Polymer traps are installed on each of the towers. The gasoline from the towers is sweetened continuously with sodium plumbite solution. No acid is required. The gasoline is gum free and high in anti-knock rating.



The boiler house which looks like a ballroom. It is at Barnsdall's Okmulgee refinery.

Only fresh 60-90 Georgia clay is used in the Gray towers. The clay is first dried in the furnace before using. The average yield is over 10,000 barrels per ton of clay.

The long residuum from the pipe still is treated with 66 Be sulphuric and neutralized with ammonia. All of the acid sludge is blended with fuel oil and fired under the boilers as liquid fuel. The oil is next filtered by percolation through Georgia clay. The filter plant is most modern, equipped with conveyors for handling the spent and revivified clay. The clay is reburned in a multiple hearth furnace.

The filtered oil is next diluted with naphtha and taken to the chilling plant. Three insulated batch chilling tanks are used to reduce the temperature of the solution to 0 degrees F. It is then pumped through the continuous, direct expansion chillers, which reduce the temperature to below minus 40 degrees F. It is then dewaxed by means of centrifuging machines. There are two batteries of ten each of these machines installed in the plant. Refrigeration is obtained by means of two absorption units and one compression unit, which produce in all about 325 tons of refrigeration.

The wax-free oil solution is reduced in a battery of six shell stills. Four of these stills are operated continuously and take off the naphtha. Two of the stills are operated semi-continuously and take a neutral cut overhead. The neutral cut is then rerun for flash and viscosity.

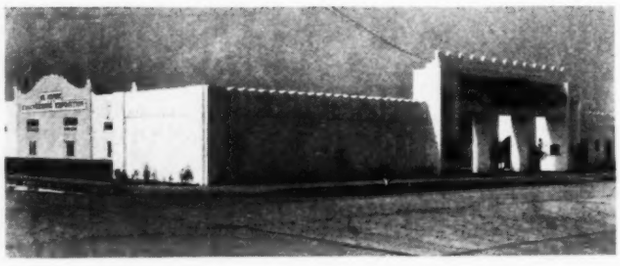
The oils from the stills are brightened by percolation through clay, and the last traces of clay are removed in a leaf type press. All of the lubricating oil produced in this manner show a pour test below 0 degrees F.

Modern research and testing laboratories are maintained at the plant. A new two-story office building was completed during the year. A well-equipped first-aid department is maintained in this building to take care of all accidents to employees. Steam for the refinery is generated by means of eight 250-horse-power water tubular boilers, and an auxiliary battery of ten 175-H. P. return tubular boilers.

Car shop for repairing, cleaning or painting tank cars is maintained at the refinery.

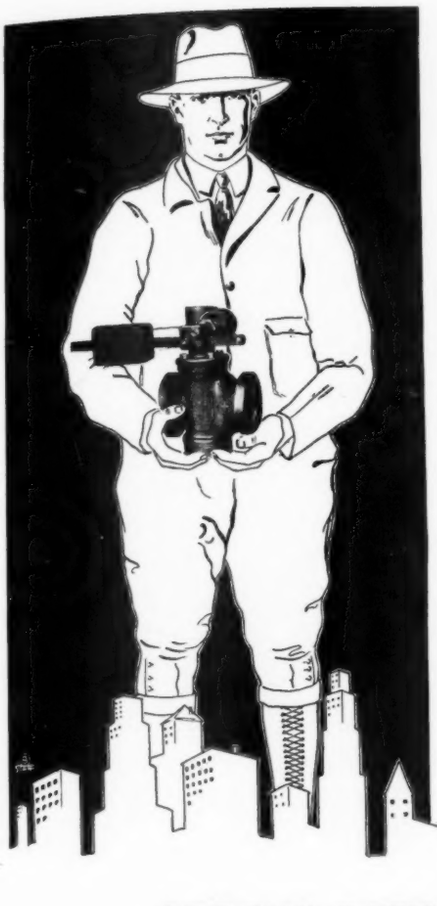
California Oil Show Will Exhibit New Patents

MANUFACTURERS are frequently desirous of obtaining inventions, and the inventors are equally desirous of presenting their patents for inspection. In order to render assistance in this matter, the Oil Equipment and Engineering Exposition will give free exhibiting space in the second annual exposition to be held from March 16 to 22, 1931, for the showing of models or drawings of new devices.



These tools will be inventions only; no products that are being manufactured will be shown in this display. Each one will bear the name and address of the inventor, a complete description of the device, a statement of its purpose and the claims made for it.

The Oil Equipment and Engineering Exposition is also making a 40 by 80-foot extension to the main building. This will be used exclusively as a meeting place for the various petroleum technical societies both during the annual exposition and throughout the year. Several of the societies have a membership scattered over the various oil fields and the location of the exposition building offers them a more central meeting place than can elsewhere be found. A screen for slides and motion pictures will be permanently placed. Facilities for darkening the room readily during daylight hours will also be provided to insure the best results at all times. No charge for this room will be made to any of the societies and they will be privileged to hold monthly or other period meetings here throughout the year.



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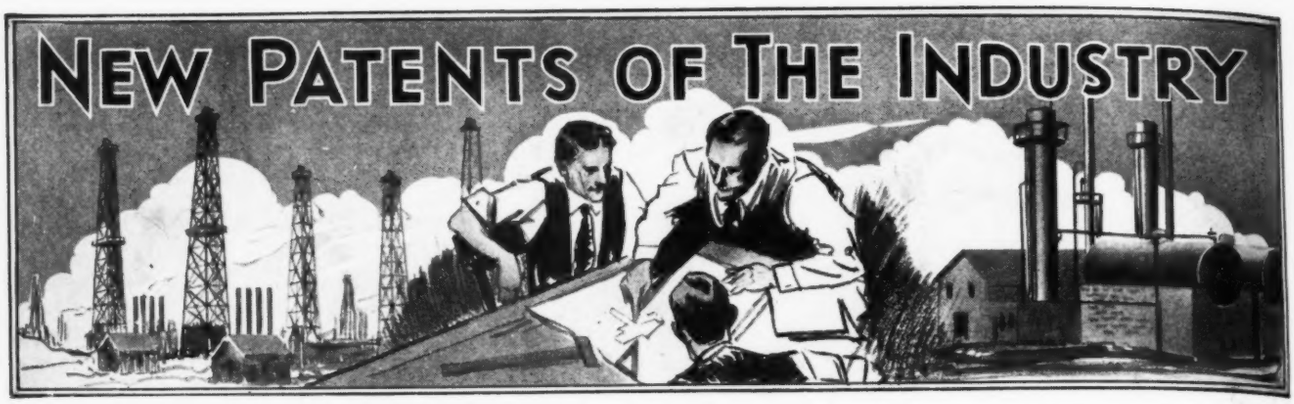
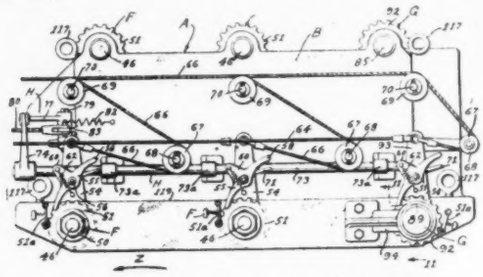
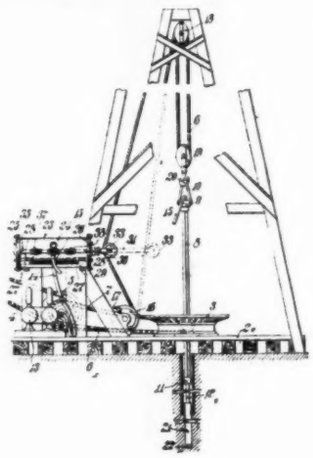


1,784,007. CAPPING-DEVICE VALVE FOR WELLS. JOHN W. HALL, Santa Ana, Calif. Filed Jan. 2, 1929. Serial No. 329,899. 20 Claims. (Cl. 166—15.)



1. A valve of the character disclosed including a body comprising separable body portions, said body being provided with an opening, a closure member for such opening, operating means for said closure member, and assembling devices connecting the body portions, in combination with a guiding member associated with one of the body portions and adapted to coact with another of the body portions.

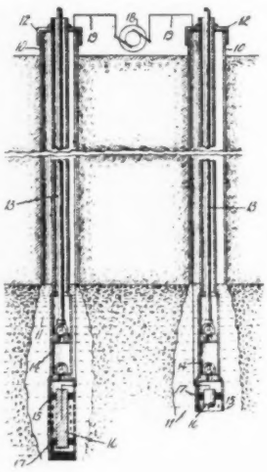
1,784,154. DRILLING APPARATUS. JOSEPH S. MITCHELL, Chicago, Ill., assignor to Sullivan Machinery Company, a Corporation of Massachusetts. Filed Oct. 17, 1925. Serial No. 63,147. 4 Claims. (Cl. 255—19.)



1. In a rotary oil or gas well drilling apparatus, the combination with a rotary table, rod line, and hoisting mechanism including a hoisting drum and a hoisting cable supporting the rod line, of means for feeding and controlling the rod line including an auxiliary feeding device having means engaging the hoisting cable intermediate the ends thereof, the connection between the hoisting drum and rod line on which the feeding device acts being deflected upon initial feeding of said device and being slackened during feeding until it assumes a straight line when the limit of feed of said device has been reached, said connection being so arranged that a predetermined feeding movement of the feeding device effects a substantially reduced feeding movement of the rod line.

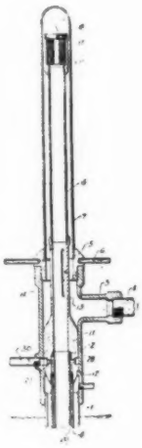
1,784,214. METHOD OF RECOVERING AND INCREASING THE PRODUCTION OF OIL. PAUL E. WORKMAN, Dallas, Tex. Filed Oct. 19, 1928. Serial No. 313,458. 7 Claims. (Cl. 166—21.)

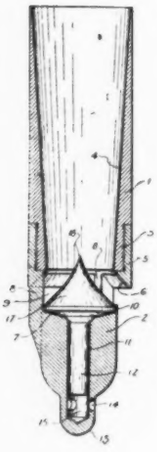
1. The method of recovering oil consisting in introducing into a well an electrode insulated from ground and immersed in the water present in the well, and feeding to said electrode a current of sufficient strength to release elements of the water by electrolysis.



1,784,110. BUFFER FOR WELL SWABS. NORMAN H. RICKER, Houston, Tex., assignor to Hughes Tool Company, Houston, Tex., a Corporation of Texas. Filed Aug. 24, 1929. Serial No. 388,189. 7 Claims. (Cl. 103—52.)

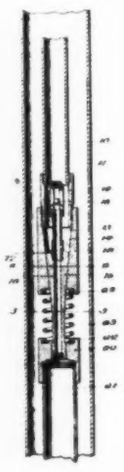
1. In a pneumatic swab structure, an eduction tube, a plunger therein, a downwardly opening valve in said plunger, a nipple at the upper end of said eduction tube, there being lateral liquid discharge openings adjacent the lower end of said nipple, means to allow the introduction of pressure fluid below said plunger, and means in said nipple to be engaged by said plunger and absorb the force of its upward movement.





1,784,096. FLUID-OPERATED SWAB. HAROLD W. FLETCHER, Houston, Tex., assignor to Hughes Tool Company, Houston, Tex., a Corporation of Texas. Filed July 23, 1929. Serial No. 380,349. 5 Claims. (Cl. 103—52.)

1. A swab construction including a cylindrical body, a head of smaller diameter than said body, said head including a ring having a valve seat on its lower side, a valve below said seat, a stem on said valve, and means to deflect the flow of fluid away from said stem and said valve.



1,784,050. DUMP AND SEAL-TUBING VALVE. HOWARD F. FORTINBERRY, Fort Worth, Tex., assignor to Gulf Production Company, Houston, Tex., a Corporation of Texas. Filed Aug. 30, 1929. Serial No. 389,512. 9 Claims. (Cl. 103—220.)

1. In a device of the character described, the combination of a working barrel, a valve seat carried by said barrel, a coupling spaced below said barrel, said coupling and barrel being movable toward and from each other and a valve attached to said coupling and operatively associated with said valve seat, foreign material within said barrel being free to escape at a point between the coupling and valve seat member when said valve is unseated by movement of the barrel and coupling toward each other.

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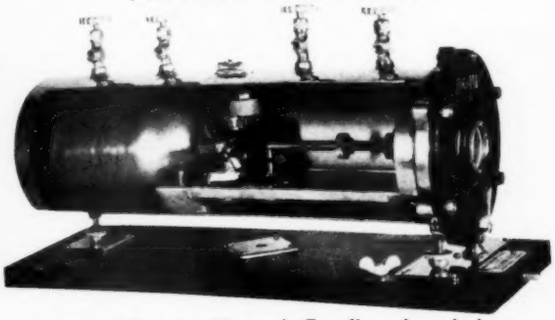

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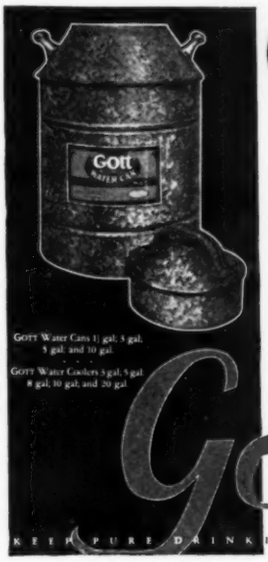

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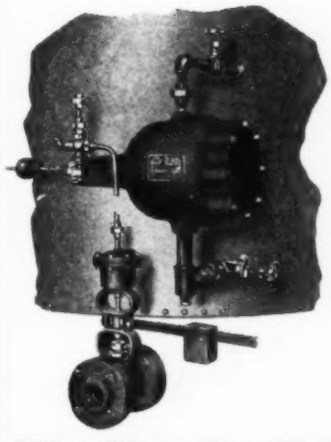

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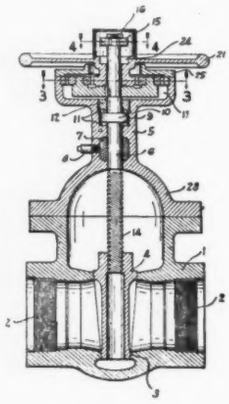
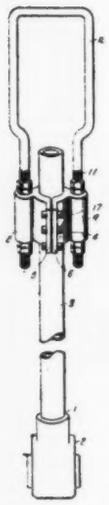
1,784,094. VALVE-OPERATING MEANS. HAROLD W. FLETCHER, Houston, Tex., assignor to Hughes Tool Company, Houston, Tex., a Corporation of Texas. Filed Apr. 6, 1928. Serial No. 267,891. 10 Claims. (Cl. 251—54.)

1. In a device of the character described, the combination of a rotatable stem, a housing for said stem, and means to rotate said stem at different speeds, said rotating means including a handle slidable and rotatable on said stem, means operative when said handle is in one position, to engage said handle nonrotatably with said stem, a spider fixed to said stem, a speed reduction gearing associated with said spider, and means on said handle adapted, when in a different position, to engage said spider through said speed reduction gearing for the purpose described.

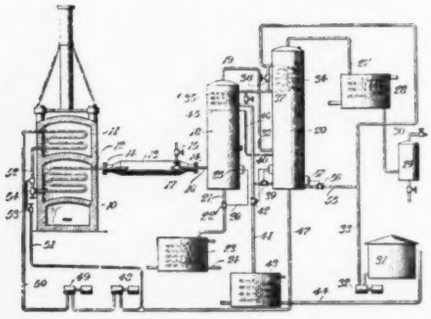


1,784,003. WALKING-BEAM STIRRUP. HARRY H. FRANKS, Tulsa, Okla., assignor of three-fourths to Tidal Oil Company, Tulsa, Okla., a Corporation of Oklahoma. Filed Dec. 9, 1929. Serial No. 412,796. 5 Claims. (Cl. 74—47.)

1. A pitman connector including in combination with a pitman rod, a bracket on the rod, and a stirrup adjustably mounted on the bracket.



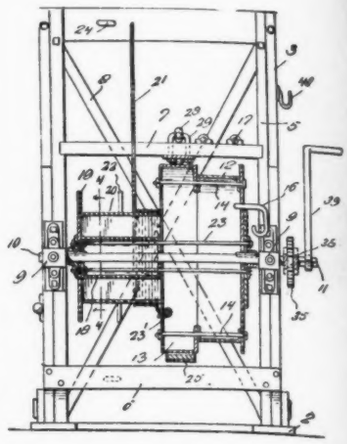
1,784,065. METHOD OF CRACKING HYDROCARBONS. GEORGE C. HARGROVE, Westfield, and WALTER B. MONTGOMERY, Elizabeth, N. J., assignors, by mesne assignments, to Gasoline Products Company, Inc., Wilmington, Del., a Corporation of Delaware. Filed Dec. 20, 1927. Serial No. 241,295. 6 Claims. (Cl. 196—47.)



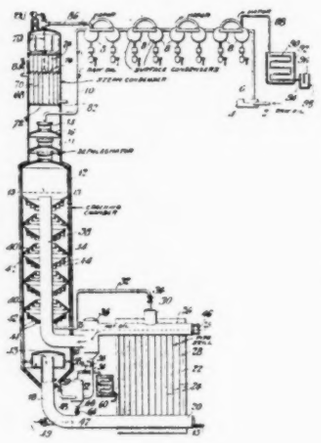
3. A process of converting hydrocarbons which comprises continuously forcing a stream of heavy hydrocarbons under pressure through a cracking apparatus, supplying heat to said cracking apparatus to raise the oil therein to a cracking temperature, shutting off the supply of said heavy hydrocarbons when sufficient carbon has deposited in said apparatus to render it desirable to remove the same, displacing the heavy hydrocarbons in the cracking apparatus by a relatively light hydrocarbon distillate, and then shutting off the supply of heat to said cracking apparatus, and reducing the pressure on the hydrocarbons contained therein.

1,784,311. OIL-WELL PULLING MACHINE. MILES DARWIN PERRY, Parkers Landing, Pa. Filed Sept. 21, 1928. Serial No. 307,535. 2 Claims. (Cl. 254—184.)

1. In an oil well pulling machine of the class described, a horizontally disposed driven shaft, a support therefor, actuating means for said shaft, a low speed winding drum secured on the shaft for rotation therewith, and a high speed drum detachably secure around the low speed drum for rotation with said shaft, said high speed winding drum including complementary sections, hinges connecting the sections, and means consisting of the cable on the drum sections for securing the sections against accidental swinging movement relative to one another on said hinges during the winding operation.



1,784,087. PROCESS AND APPARATUS FOR THE TREATMENT OF OIL. DAVID G. BRANDT, Westfield, N. J., assignor to Doherty Research Company, New York, N. Y., a Corporation of Delaware. Filed Jan. 31, 1922, Serial No. 532,954. Renewed July 11, 1928. 20 Claims. (Cl. 196—59.)



5. The process of producing low boiling point hydrocarbons from high boiling point hydrocarbon oils, which comprises maintaining a body of oil in a cracking zone, passing oil from said zone through a heating zone at a relatively high velocity whereby a portion of said oil is vaporized, passing the unvaporized oil at a relatively low velocity from said heating zone directly into the body of oil in said cracking zone, independently passing the vapors from said heating zone and percolating them through the oil body in said cracking zone.

1,784,242. APPARATUS FOR INDUCING FLOW OF OIL FROM WELLS. WENDELL A. MELTON, Tulsa, Okla., assignor to The J. A. Hull Co., Tulsa, Okla. Filed Sept. 25, 1926. Serial No. 137,741. 2 Claims. (Cl. 103—232.)

1. In combination with well casing, sectional tubing, two lower tubing sections having interior screw threads at their adjacent ends, said ends being in abutment, a nozzle having an exteriorly threaded body coupling said tubing sections to enclose the nozzle by the tubing and having an upwardly directed reducing nipple, the upper part of said tubing sections having upwardly inclined ports opening inwardly about the nipple, a packer between the tubing and casing below the ports, means for sealing the top of the casing, and means for delivering artificial pressure medium to the space between the tubing and casing above the packer.